RAILROAD GAZETTE

FRIDAY, FEB. 24, 1893.

CONTENTS.

Contributions.

Ventilation of Sleeping Cars.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your editorial in regard to the comforts of railroad coaches (Feb. 17) was to the point, as your editorials always are, but why not include the sleeping and parlor cars in your suggestions? By implication one would assume that you consider their comforts beyond criticism. You speak of the ventilation in certain coaches being "watched by an intelligent trainman." Did you ever see the ventilation of a sleeping car watched by an intelligent porter? If so, I am sure his duties were limited by the "watching." In the mind of the porter, as with the majority of other people, however, ventilation and draft are synonymous terms; so to produce the desired result he opens the ventilators in pairs directly opposite each other. He succeeds admirably.

Some time since I was crossing the plains in a Union Pacific train during a winter month. A cold gale was blowing from the north. The car was insufferably hot. A few of the passengers asked for ventilation, whereupon the porter opened the ventilators on both sides of the monitor. The other passengers promptly demanded their closing on account of the fearful draft. The two factions kept up the contest all the morning, the ventilators being alternately opened and closed. When the passengers had all gone into the dining car for luncheon, I called the porter, gave him a quarter and a short lecture on ventilation, and then had him open a few ventilators on the *leeward* side of the car, leaving those to windward closed tightly. On the return of the passengers there was not a word of complaint. There was ventilation which pleased all and no drafts to offend the sensitive. But I have never seen this simple and yet effective expedient tried voluntarily by a porter or trainman.

Now, as one of the suffering, cannot I ask you to wield your powerful pen to induce the sleeping car companies to give to the porters a little elementary instruction in the principles of ventilation? Those of us who, like the G. P. A. to whom your editorial is directed, ride in the sleeping and parlor cars, feel that on account of our paying an extra fare, or traveling on an annual pass, we are entitled to have our comforts attended to first. When you have done that, then you can help what Lincoln called "the plain people." W. B. P.

Is De Lesseps an Engineer?

TO THE EDITOR OF THE RAILROAD GAZETTE:

Authorities differ as to the professional status of De Lesseps. Even De Lesseps, who ought to be a good authority, was, unless misrepresented by the newspapers, vacillant on this point, for at his lecture before the American Society of Civil Engineers he utterly disavowed being an engineer, saying he was a simple diplomat. But at Washington he utterly disclaimed diplomacy, according to the newspapers, characterizing himself as an engineer. You, who apparently attended the lecture in the theatre of the Union League Club, and did not gather misinformation from the daily press, decide that it is a mistake to speak of him as an engineer, and one of your esteemed contemporaries is in accord, with a specification, as follows: "He was not an engineer, and has nothing of the training of an engineer to enable him duly to weigh the technical objections to his plans at Panama, while he had acquired at Suez a contempt for engineer's opinions, from seeing how they could be based upon scant grounds and be used for mere purposes of obstruction," referring, doubtless, to Sir John Hawkshaw's famous opinion. It might be proper to say just here that a promoter who reduces the estimate of his Engineer Commission by 184,000,000 francs, as De Lesseps did on the "Colon" coming up from Aspinwall, is quite apt to have a contempt for engineers.

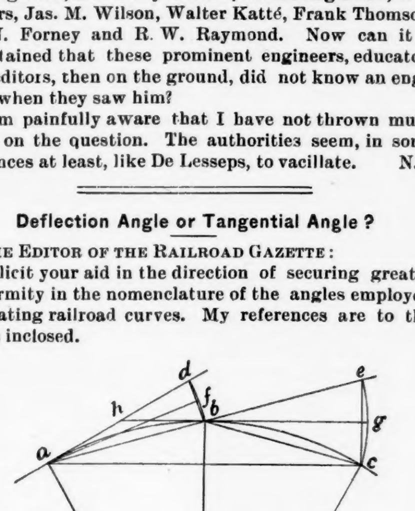
But to return to the question, which is an intricate one. The invitations to the Delmonico dinner, March 1, 1880, given in his honor, set forth that: "The eminent distinction awarded to you by your profession throughout the world, the important service your engineering and executive ability has rendered to universal commerce and civilization. . . ." The Committee of Arrangements had John Bogart and the late A. L. Holley as members, while among those who signed the invitation were Past-Presidents of the American Society of Civil Engineers, Albert Fink, Wm. E. Worthen and Octave Chanute, in company with Walter W. Evans, Q. A. Gillmore, Moncure Robinson, F. A. P. Barnard, J. James R. Croes, Chas. Macdonald, Geo. S. Morison, F. Collingwood, Dr. Henry Morton, Thomas Egleston, Wm. Sellers, Jas. M. Wilson, Walter Katté, Frank Thomson, M. N. Forney and R. W. Raymond. Now can it be maintained that these prominent engineers, educators and editors, then on the ground, did not know an engineer when they saw him?

I am painfully aware that I have not thrown much light on the question. The authorities seem, in some instances at least, like De Lesseps, to vacillate. N.

Deflection Angle or Tangential Angle?

TO THE EDITOR OF THE RAILROAD GAZETTE:

I solicit your aid in the direction of securing greater uniformity in the nomenclature of the angles employed in locating railroad curves. My references are to the figure inclosed.



The Field Books of Henck and Searles apply the name "deflection angle" to the angle *d a b* formed between a 100-ft. chord *a b*, and a tangent *a d* at one end of that chord, which is the constant angle $dab = bac$ turned off (or "deflected") by the transitman from one point *a* in locating points *b*, *c*, etc., in the curve at the ends of 100-ft. chords.

But Shunk's and Trautwine's books call this the "*tangential*" angle (owing, no doubt, to the fact that the tangent *a d* forms one of the legs of the angle) and apply the term "deflection angle" to the *double* of this, *i.e.*, to the angle *e b c* formed between one 100-ft. chord *b c* and the prolongation *b e* of the preceding 100-ft. chord *a b*; which, of course, is equal to the angle *d h b* between two tangents *a d* and *h g*, touching the curve at the two ends *a* and *b* of a 100-ft. chord, or to the central angle $a o b = b o c$ subtended by one 100-ft. chord. It is the angle through which the curve *deflects* within the length subtended by one 100-ft. chord, and is generally called the "degree of curvature."

It seems most unfortunate that so confusing a difference of nomenclature should be perpetuated, and I would ask for expressions of opinion from yourself and from your readers as to the relative merits of the two systems and the extent to which each prevails, in the hope that one pair of authors (no matter which) may be induced to bow to the inevitable and conform to general usage. SIMPLEX.

Tapping Car Wheels.

The Philadelphia & Reading Railroad Co.,
SOUTH BETHLEHEM, Pa., Feb. 8, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Mr. C. M. Leonard, of White Haven, Pa., claims to have originated many years ago the idea of tapping car wheels to see if they are sound. Can any of your subscribers give the time when this mode of testing car wheels was brought into practice on their roads? It seems but fair that the originator of this plan should receive some credit in the scientific papers.

ROB'T H. SAYRE, *Fourth Vice-President.*

The editor has asked several gentlemen for the information which Mr. Sayre wishes, and the substance of their replies follows:

Oliver W. Barnes, Chief Engineer New York & Long Island Railroad.—The custom of tapping car wheels was in use on the Pennsylvania Railroad as long ago as 1851 when I was connected with that company at Johnstown, Pa.

John M. Toucey, General Manager New York Central & Hudson River.—This practice was in vogue on the Hudson River Railroad when I entered its service in March, 1855. Mr. Buchanan, who has been in the employ of the company since the road was opened in 1851 informs me that it was the practice from the start.

W. G. Hamilton, C. E.—My first recollection of tapping car wheels was in 1848, when the firm of H. R. Dunham & Co., at their foundry in North Moore street, New York, made chilled car wheels, with split hubs, to allow for expansion. These wheels were tapped with a hammer to see if they were sound when the lead was poured in the splits in the hub. I think almost every car wheel made since that date has been so tested. The practice was probably coincident with the beginning of the manufacture of car wheels and came naturally into use on the railroads.

Charles Paine, C. E.—I remember this practice on the Michigan Southern & Northern Indiana Railroad in 1856 and it did not impress me then as being new.

William W. Lobdell, Vice-President Lobdell Car Wheel Company.—This manner of testing wheels has been in vogue with the manufacturers almost from the inception of the business. Bush & Lobdell used it back in the forties and it is still practiced by us. Mr. Sayre probably refers to tapping wheels under cars at stations. This practice originated so many years ago that our Mr. George G. Lobdell, possibly the oldest car wheel maker in the country, cannot recall its introduction.

James Moore, Consulting Engineer Central Railroad of New Jersey.—It is difficult to say, exactly, when I first knew of the tapping of car wheels. However, I can say that I caused their tapping on the Vermont Central Railroad as early as 1848 (while I was General Superintendent) on all cars running 200 miles or over. I also caused their tapping on the Michigan Southern & Northern Indiana Railroad (of which I was General Superintendent) as early as 1853, on all trains running between Toledo or Monroe and Chicago, 245 miles.

The West Albany Brake Trials.

Many of our readers know most of the causes which led up to the decision on the part of the New York Central & Hudson River Railroad Company to make exhaustive and accurate test of the Westinghouse and New York air brakes in September of last year. The two brake companies were invited to be present and inspect the methods employed, but not to take part in the collection of data, a disinterested person being employed to supervise the test and compare the results. The details of the programme of the test, which are not given with this, will be found in the *Railroad Gazette* of Sept. 16, 1892.

Mr. P. H. Dudley, whose reputation as an observer, experimenter and reasoner from observed facts, is very great, was chosen to organize and conduct the tests. It was agreed by the two representatives of the technical press who were present and by Mr. Dudley that none of the results should be published until his report was made, and either given out for publication or definitely withheld. Five months have now passed, Mr. Dudley's report is handed in, but we do not learn that there is any intention of making it public. Meantime several things have happened to give a wrong and harmful impression of the actual results of the tests. We have concluded therefore to make our own report, giving such facts as we have, and it is needless to say that we believe them to be entirely reliable, if unofficial. What is given here as a bare statement of the facts developed at the tests, and certain logical deductions therefrom; further comments appear on another page. The more complete results of the release tests and other tests not given here are equally important, and would be equally useful if they could be published, but we have not the data. However, the first office of a brake is to stop trains within the shortest possible distance in case of an emergency, without endangering the train or its lading. The tests covering this first essential of train braking are given with some completeness in what follows, but the tests pertaining to the other essentials which have more to do with the reduction of delays, cost of maintenance and the efficiency of brakes in "service" working are not touched upon, owing, as we have said before, to the lack of information.

The programme of the tests as arranged by Mr. Dudley, leaving out such parts as do not refer to the data here presented, are as follows:

Tests to be practically the same as recommended by the Committee on Air Brakes of the M. C. B. Association.

Condition of Tests.—Fifty car trains; train line pressure, 70 lbs.; piston travel, 5 to 7 in.

Standing Tests.—Locomotive and dynagraph car to be side by side on parallel tracks; 25 cars attached to the locomotive and 25 to the dynagraph car; the air hose of the 25th and 26th connected; the first and fiftieth cars connected by air pipes to the instruments in the dynagraph car.

Running Tests.—One train of 50 cars will be placed on track No. 3 and the other on track No. 4, then run side by side from Athens Junction to Karners, at same

speed. Locomotives shut off at signal post. Air automatically applied by tripping block.

Application Tests.

5. Time of development of pressure in cylinders from first to fiftieth car. Service application and release.
6. Same as No. 5. Emergency application and release. Repeated three times.
7. Time of development of pressure in cylinders, the 5th, 6th and 7th cars cut out. Emergency application and release. Repeated three times.
8. (Special and optional).
Same as No. 7, except the 5th to the 10th car inclusive cut out.

Graduation Tests.

9. A reduction of 8 lbs. in train line pressure will be made; then at one minute intervals, further reductions of 4 to 6 lbs. to be made until reservoirs and cylinders are equalized.
Repeated twice.
10. Service application.
Fifteen lbs. to be admitted into cylinders, pressure noted then at the 5th, 10th and 15th minutes.
11. Same as No. 10, except all the air to be exhausted from train line by emergency application.

Release Test.

Boiler pressure, 160 lbs.

12. Seventy lbs. in train line; all the air will be discharged by an emergency application. A pressure of 90 lbs. will then be maintained against a diaphragm ⅛ of an inch thick, perforated with a 3-32 hole, and a record taken of all brakes which release in 30 minutes.

Test to determine the sensitiveness of the emergency valve.

13. The 1st and 50th car will be cut from train and hose connected. Seventy pounds train pipe pressure will then be discharged through a diaphragm perforated with a $\frac{3}{32}$ hole. Each car to be treated singly, if desired.
14. Tests to determine time of charging one auxiliary reservoir. Cars arranged as in test No. 13. Cut out brakes, bleed reservoirs. Secure 90 lbs. pressure in main air reservoir and train line. Shut off pump. Note time of charging reservoir to 70 lbs.

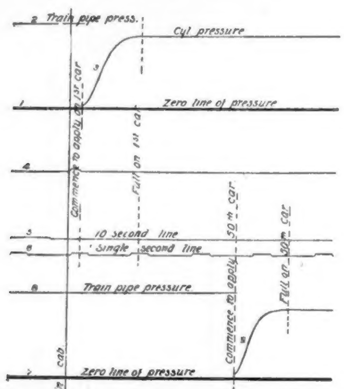


Fig. 1—Westinghouse Brake.

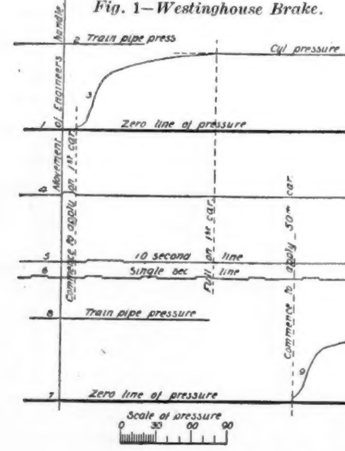
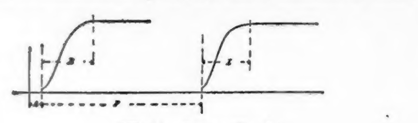


Fig. 1—New York Brake.

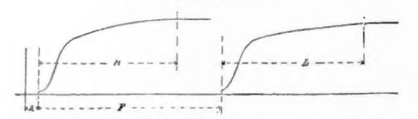
The preliminary tests showed that the train pipes of the two trains were in good condition and free from important leaks. The length of the 1¼ in. pipe which connected the twenty-fifth and twenty-sixth cars was about 30 ft.

The recording apparatus in Mr. Dudley's dynagraph car was arranged to cause a tape about 2 ft. broad to travel at a practically uniform speed. Upon this tape the different elements were recorded by pens. Two of these were connected with ordinary steam engine indicators which were connected with the brake cylinders, and others were connected with electro-magnets for recording the times, etc. The diagrams in fig. 1 are fair representatives of the character of all the diagrams taken from each brake. In this figure the line No. 4 is drawn by the pen connected by electric circuit with the engineer's brake valve, so that at the instant that he applies the brake a jog will appear in the line. Lines 5 and 6 are drawn by pens controlled by electric circuits leading to a clock. The jogs in the line 5 occur every ten seconds, and those in line 6 occur every second. Line 1 is the base line of the diagram of the performance of the brake cylinder upon the first car. Line 2 indicates the train pipe pressure at the forward end of the train, just prior to the experiment, the indicator having been connected up to the train pipe for this purpose. Line 3 is the pressure line for the cylinder of the first car during the experiment. Line 7 is the base line of the diagram of the cylinder upon the fiftieth car. Line 8 indicates the train pipe pressure at the rear end of the train just prior to the experiment, and line 9 is the pressure curve of the cylinder of the fiftieth car. The scale reading the ordinates of the diagrams was practically 32 lbs. to the inch, and is given in reduced form on fig. 1. The base lines 1 and 7 and the lines 4, 5 and 6 are all parallel. The perpendicular lines passing through the points indicating the time of application of the brake by the engineer on line 4, the point of initial entrance of air to the cylinder of first car, the point of full pressure in the cylinder of first car, the point of initial entrance and full application of air in the cylinder of last car, serve to indicate the difference in time between these events.

In fig. 2 the base lines of the diagrams of the cylinders of the first and fiftieth cars are made to coincide and the lines 4, 5 and 6 are not shown, but the measurements are indicated by letters and tabulated in Table *A*.



Westinghouse Brake.



New York Brake.

Fig. 2.

In this figure the vertical line at the left denotes the instant of application of the brakes by the engineer's valve. The diagram next to the right is that from the cylinder of the first car, and that further at the right is the diagram of the cylinder of the fiftieth car.

The time elapsing between the application of the brakes by the engineer's valve and the initial entrance of air to the brake cylinder of the first car is represented by *A*. The time elapsing from the initial entrance of air to the time of full pressure in the cylinder of the first car is denoted by *B*. The time elapsing from the initial entrance of air into the cylinder of the first car to the initial entrance of air into the cylinder of the fiftieth car is represented by *F*. The time elapsing between the initial entrance and full pressure of air in the cylinder of the fiftieth car is denoted by *L*—all in seconds.

TABLE *A* GIVING RESULTS OF TEST NO. 6.

Brake.	No. of trial.	*A*.	*B*.	*F*.	*L*.
Westinghouse	1	.30	1.00	2.60	.90
"	2	.20	1.00	2.60	.90
"	3	.20	1.00	2.55	.90
New York....	1	.25	3.35	3.13	2.82
"	2	.24	2.96	3.06	2.90
"	3	.28	2.92	3.02	2.90

TABLE *B* GIVING RESULTS OF TEST NO. 7.

Brake.	No. of trial.	*A*.	*F*.	Remarks.
Westinghouse....	1	.20	2.60	
"	2	.20	2.70	
"	3	.20	2.70	
New York........	1	.20	3.70	
"	2	.....	...	Failed to apply.
"	3	......	....	"
"	4	....	....	"
"	5	.25	4.20	

NOTE.—Test No. 7 was made three times for each brake. In the case of the Westinghouse brakes, the jump was accomplished and the brakes applied at the rear in each trial. The New York brakes applied the first time, but failed to apply in the second and third trials. They were then given a fourth trial and again failed. In a fifth trial they were again successful in jumping the cut-out brakes and applied throughout the train.

Test 8. This test was tried with the Westinghouse train, but in each case the brakes failed to jump the six cut-out cars, and the applications did not extend throughout the train. This test was not attempted with the New York brakes.

Test 9. No complete record of this test is obtained. The 50 Westinghouse brakes applied at the first reduction of 8 lbs. in each trial. The cylinder pressures increased with each subsequent reduction of train-pipe pressure until the pressures in the brake cylinders and reservoirs became equalized. The New York brakes did not all apply at the first reduction of 8 lbs. In one trial 12 brakes refused to apply. During the subsequent reductions, some of these applied. In one trial 4 are known to have not applied at all, even after all the reductions were made, while others had leaked off.

Test 10. The results of this test have not been obtained.

Test 11. This test was changed from that laid down in the schedule. It consisted of an emergency application, the train pipe being left open to the atmosphere and, at the end of thirty minutes, the number of brakes which had leaked off was noted.

With the Westinghouse train four brakes leaked off. One of these was upon the 50th car and connected to the dynagraph car by pipes which were not tight and caused the leakage. The blowing out of a portion of the rubber gasket between the cylinder and reservoir of another brake caused the air to quickly escape.

In the test of the New York train the brakes were properly applied, but at some later time the handle of the engineer's valve was returned to the lap position by some unauthorized person, thus closing the end of the train-pipe and allowing the air which leaked back into it through the triple valves to collect. The engineer subsequently discovered that a pressure of 16 lbs. had collected in the train pipe, and he turned the handle of the engineer's valve again into the emergency position. The brakes which had before leaked off then applied again. While this accident thus furnished the information that the brakes were leaking off through the triple valves, it prevented a proper determination of the number of brakes which would leak off in 30 minutes. As it was, the number which had gone off at the end of the 30 minutes was 14. This test was not of real practical value owing to the fact that it was not well carried out and was not repeated.

Test 12. The object of this test was twofold, (*a*) to determine the certainty of release and (*b*) to test the brakes for tightness. The argument about it is as follows: With the emergency application the brakes are set with about 60 lbs. pressure, and if there is no leakage in the train-pipe the train-pipe pressure must be raised to about 62 lbs. to cause release to take place. On the other hand if the brakes leak down to a lower pressure then a lower pressure will be required in the train-pipe to effect release. For instance, if the brake release at 12 lbs. train-pipe pressure, it shows that the brake had leaked from 10 to 11 lbs. Hence the leakage is directly indicated by the pressure at which release takes place. The lower the pressure of release the greater is the evidence of leakage, and the more rapid the leakage the easier is release accomplished. If the brakes leak rapidly enough they will release themselves in the 30 minutes of time allotted for the trial without a material raise of train-pipe pressure. This was shown in the case of a brake which had a fractured gasket between the reservoir and cylinder.

In the test of the Westinghouse train there were three brakes which failed to release when the train-pipe pressure was raised to 63 lbs. Of those which released three went off quickly and at low train-pipe pressures. One of these had the fractured gasket and the other two were those connected by leaking pipes to the recording apparatus. None of the remainder released below about 50 lbs. train-pipe pressure.

In the test of the New York train only one brake failed to release after the pressure in the train-pipe had been raised to 63 lbs. About one-half of the brakes had released, however, when the train-pipe pressure reached 30 lbs.

Test 13. Both brakes when tested with a single car attached to the locomotive went on with the emergency application. This showed that the arrangement of apparatus was defective, that is, either the diaphragms were larger than the specified $\frac{3}{32}$ of an inch or there was some other unusual cause for such action. This appears from the fact that the $\frac{3}{32}$-in. diaphragm was chosen by the M. C. B. committee as one that should not permit a brake to go on with the emergency application in service work, it having been ascertained that this size of diaphragm will not allow the Westinghouse brake to go on with the emergency when the diaphragm is accurately made and properly arranged. This fact makes Test No. 13 of little or no practical value.

Test 14. This test did not furnish useful information with either brake owing to the considerable leakage from the reservoir through the pipe connections to the recording apparatus. This leakage was so great that the noise of the escaping air could be distinctly heard by observers of the tests. The "feeding-in" part of the triple valve through which the air passes to the reservoir is exceeding small, and any leakage from the reservoir that could be perceived by the ear is of sufficient magnitude to remove all practical value of the results.

RUNNING TESTS.

The preparations made by Mr. Dudley for the running tests were very elaborate, and probably the most accurate ever made with train brakes. Especially in the running tests the provisions were such as to almost completely eliminate those variations in conditions which have hitherto rendered the results of comparative brake trials somewhat doubtful and have caused more or less controversy. In the running trials at Karners the trains ran upon level parallel tracks. The locomotives were from the same lot, manufactured by the Schenectady Locomotive Works, and all the cars of both trains were manufactured at practically the same time in one lot, by the Buffalo Car Manufacturing Com-Company. As both trains were run at the same time and the brakes applied automatically at the same point, all questions of grade, speed, condition of the rail and error on the part of the engineer were eliminated. The only variation in conditions appears to be that of the train-pipe pressure, correction for which is readily made. As the cars of both trains had been placed in service for about three months prior to the trials, the condition of cars and apparatus at the time of the trials was such that the results may, to a considerable degree, be looked upon as representative of what may be expected in ordinary service.

The weather was most admirable, the condition of the rail excellent, and, as the trains were run upon paralle tracks, at the same speeds, the accuracy of the results seems to be above suspicion in all cases, except that o running test No. 4.

There were seven running tests. The first four were *emergency* stops of both trains, running side by side The fifth was a stop made through a *full service* appli

cation of the brakes on both trains, the air being allowed to escape from the train pipe through as large an opening as possible, without causing an emergency application of the brakes. Stops six and seven were to have been made by single trains, each made up of 25 Westinghouse brakes and 25 New York brakes, intermixed, so that five consecutive brakes were of one system, the next five of the other system, and so alternating throughout the train. By some error in shifting the cars to make up these two trains that which was used in test No. 6 consisted of but 45 cars, and that used in test No. 7 consisted of 55 cars.

TABLE C, GIVING RESULTS OF RUNNING TESTS.

Brake.	No. of Stops	Train-Pipe Pressure.		Speed.	Distance	Slidometer.	
		Front.	Rear.			Front.	Rear.
Westinghouse	1	68	68	26.78	270	+¼+¾	4
"	2	58.5	68	32 0	373	+¼+¾	½
"	3	54.5	65	34.48	472	+½	½
"	4	70	71	31.39(?)	325	0	6
"	5	68	68	28.39	844	0	3
New York	1	71	71	26.78	310	+1¾	26½
"	2	71	70.5	32.0	450	+½+¾	31
"	3	69	70	34.48	496	+⅛+⅛	28¼
" ...	4	65	63	31.88(?)	417	+⅞	26½
"	5	70.5	70.5	28.39	9?7.5	+⅜	1¼
Mixed.........	6	65	63	27.75	325	0	10¼
"	7	72	70	30.	344	+¼+¾	23½

REMARKS ON TABLE OF RUNNING TESTS.

In No. 3 stop, Westinghouse train parted between cars 6 and 7 and became separated by a distance of 34.8 ft. In the same stop, the New York train parted between cars 12 and 13 and became separated by a distance of 38.3 ft.

In stop No. 4 both trains parted and were separated by distances not noted.

In stops 6 and 7 the train parted (in two places in No. 6) and a small separation occurred.

In order to make the lengths of stops exactly comparable, it is necessary that the equivalent length of stop, for the standard train-pipe pressure of 70 lbs. and a particular speed, should be found for each of those which took place. The standard train-pipe pressure is 70 lbs. and, in making these reductions, the train-pipe pressure indicated for the front end of the train is used, being considered the most reliable. The speed chosen as being about an average is 30 miles an hour, and the lengths of all emergency stops are reduced to this speed.

To remove any question of difference in conditions on account of difference in locomotives, the locomotives were changed after emergency stop No. 3, so that the one which had been hauling the Westinghouse train during the first three stops hauled the New York train during the fourth and fifth stops, and *vice versa*. It will be observed that the relations between the stops of the two trains did not appear to be in anywise affected by the change.

It is necessary to make corrections for the distance of each train in stop No 3 on account of the parting of the train. Where the distance is measured at the head end of the train, a "break-in-two" will cause the forward section of the train to travel further than it would have done, if it had remained attached to the rear end, on account of the smaller proportion of braking force on the forward section, due to the locomotive. The effect of such parting of the train upon the forward end depends, therefore, upon the relative proportions of the train in the forward and rear sections. It is readily demonstrable that the correction to be subtracted from the distance, as measured at the forward end of the train, is equal to the product of the interval of separation between the two sections and the total braking force upon the rear section of the train, divided by the total braking force of the whole train.

The table D shows the results of the running tests corrected for parting of train, train-pipe pressure and speed.

TABLE D, GIVING RESULTS OF RUNNING TESTS CORRECTED FOR PARTING OF TRAIN, TRAIN-PIPE PRESSURE AND SPEED.

Brake.	No. of stop.	* Distance	Dist. corrected for separation.	Train-pipe press.	Dist. con. for press.	Speed.	Dist. reduc'd to speed of 30 miles per hr.
Westinghouse	1	270	....	68.	264.1	26.8	321.7
"	2	373	....	68.5	366.6	32.	327.
"	3	472	444	61.5	415.3	31.5	324.
"	4	325	....	70.	325.	31.4 30.4	300.1 317.5
New York	1	310	....	71.	313.2	26.8	380.1
"	2	450	....	71.	455.6	32.	406.4
"	3	496	470	69.	464.8	34.5	365.0
"	4	417	....	65.	394.4	31.9 30.9	355. 374.6
Mixed.....	6	325	....	65.	306.9	27¾	351.7
"	7	344	....	72.	351.3	30.	351.3

As before stated, there should have been a correction in stop No. 4 of each train, on account of separations of the trains, of which proper notes were not made. The speeds of the two trains were different in this stop, and this is the only case in which any question of difference of speed arose. The first speeds deduced by Mr. Dudley were as shown by the upper figures in the bracket. The reduction of these stops to a speed of 30 miles per hour and the proper train-pipe pressure would indicate a very considerable discrepancy between the results of stop No. 4 and the average of those of the other three emergency stops. This discrepancy would be still increased, if a proper correction was made for the parting of the trains. Had the speeds been 30.4 miles an hour for the Westinghouse train, and 30.9 for the New York train, the stops, reduced to 30 miles an hour, would still have been below the average of the other three, for both trains. Mr. Dudley considers that the recorded speeds in this test are not reliable, and therefore the distances found for test No. 4 are thrown out, and do not influence the averages found below.

The following table, E, shows the averages of the lengths of the emergency stops, for a speed of 30 miles per hour, of each train, and the averages of the shocks of each.

TABLE E., GIVING AVERAGE LENGTHS OF CORRECTED STOPS AND AVERAGE SHOCKS.

Brake.	Speed.	Distance.	Shock.
Westinghouse.	30	321.2	2¾
New York	30	3?3.8	28 1/16
Mixed..........	30	351.5	16⅞

NOTE.—The shocks in the forward car of each train were uniformly very light. Those which occurred caused a forward movement of the slidometer. In some cases, two separate forward movements occurred; but, as will be seen by reference to the table, all were insignificant and merit no further consideration.

ANALYSIS OF BRAKE CYLINDER DIAGRAMS.

The use of the indicator gives accurate and instructive information concerning what takes place in brake cylinders during the period of emergency application of the brakes. There is but one apparent error introduced into the results of the standing tests, which affects only the length of time elapsing between the initial entrance of air into the cylinders of the first and fiftieth cars. This error is principally due to the use of the extra length of pipe and additional hose and couplings inserted between the 25th and 26th cars. The amount of the error was determined as follows: The average of the time F (see figs. 1 and 2), in test No. 6, for the three trials of the Westinghouse brake is 2.58 sec. During the running tests of the train, when the unusual length of pipe between the 25th and 26th cars was removed, an electric chronograph upon the Westinghouse train gave as the average time elapsing between the application of the brakes at the first and fiftieth cars, 2.43 sec. This indicates that the time F, for both trains, as shown in the standing tests, was .15 sec. greater than it should be.

Making corrections for this error, the average time of the beginning of the application on the 50th car would become for the Westinghouse train, 2.43 sec. and, for the New York train, 2.92 sec.

A fact of great importance was also recorded in test No. 7. By comparing the average of the times of application, F, in the three trials of the Westinghouse brake in test No. 7 with the average in test No. 6, it will be seen that the former, where three consecutive brakes were cut out of use, was .09 sec. greater than the latter. While with the New York brake, which failed to apply in three trials, the differences are .63 sec. and 1.13 sec.

In addition to the information in regard to the length of time elapsing between the initial entrance of air into the cylinder of the first car, the indicator diagrams also show the differences in the length of time required in the two brake systems, to acquire full cylinder pressure after the air has begun to enter it. This matter also has an important bearing on the behavior of the brakes. If the brakes could be at once applied with full pressure, the greatest retarding effect would be brought upon the train, and the nearer the approach to such an application of the brakes the better the results will be in point of length of stop and shock.

It is evident that, if the air commences to enter the cylinders at one time and the pressure is gradually increased, the retarding effect upon the train would be the same as if the full pressure was instantly applied at some time later than the time of first entrance of pressure into the cylinder.

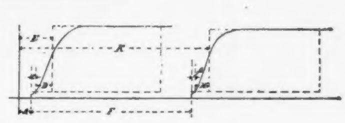
With the aid of the indicator diagrams, this intermediate time has been found, in the same manner that the mean effective pressure in the cylinder of a steam engine is found from the indicator card.

The method by which this has been done is outlined in fig. 3. It was found that the resistance of the release springs, together with the frictional resistance of the brake gear, was sufficient to require a pressure of 5½ lbs. in the cylinder to move the brakeshoes so that they came in contact with the wheels. In each one of the indicator diagrams there is therefore drawn a horizontal line at a height corresponding to 5½ lbs. above the base line. The point at which this line cuts the pressure curve determines the instant at which the brake shoes come into contact with the wheels. At the right from this point on the 5½ lb. line is laid off a convenient distance, of sufficient length to reach beyond the point where full pressure is realized in the cylinder. A vertical line is drawn at this point to the pressure line. The area of the figure inclosed by this vertical line, the 5½ lb. line and the pressure curve is then ascertained. The quotient of the area thus found, divided by the length of the vertical line at the right, is the base of a rectangle laid off to the left from the vertical line and which incloses an area equal to that of the original diagram. In other words, the work done in retarding the car would be the same if the brakes had been instantly applied, so that the diagram would have been the rectangle shown instead of that which actually occurred. The line E therefore represents the interval of time which would elapse, after the application of the brakes by the engineer's valve, to an instantaneous full application of the brakes on the first car, which application would produce the same retarding force upon the car as that which was produced by the more gradual application indicated by the actual diagrams.

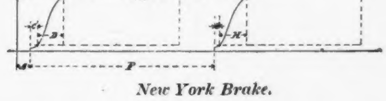
In like manner the line K represents the time elapsing from the application by the engineer's valve to an instantaneous full application of the brake on the rear car. Since the applications of the brakes to the cars intervening between the first and fiftieth occur in uniform succession at regular intervals, the mean of the times E and K therefore represents the time that would elapse between the application of the brakes by the engineer's valve and an instantaneous full application of the brake upon every car of the train, and which would produce the same retarding effect upon the train as that which was actually produced.

The areas of the diagrams taken from the cylinders of the first and last cars of each train in each trial of test No. 6 were accurately measured, and the results are shown in Table F.

The interval F, between the initial entrance of air into the cylinder of the first car and that in the cylinder of the last car, has in each case been corrected by the subtraction of .15 second from the time F, shown under test No. 6, in order to correct for the pipe between the twenty-fifth and twenty-sixth cars. The times D and H depend upon the above explained calculations all other times have been directly measured upon the original diagrams.



Westinghouse Brake.



New York Brake.

Fig. 3.

TABLE F, GIVING THE ANALYSIS OF THE CYLINDER PRESSURE DIAGRAMS.

	Westinghouse brake.			New York brake.		
	1.	2.	3.	1.	2.	3.
A..........................	.30	.20	.20	.25	.24	.28
C..........................	.09	.09	.08	.15	.14	.15
D..........................	.26	.26	.23	.62	.54	49
E..........................	.65	.55	51	1.02	.92	.92
F..........................	2.45	2.45	2.40	2.98	2.91	2 87
G..........................	.05	.05	.05	.05	.05	.07
H..........................	.22	.21	.23	.54	.50	.51
K..........................	3.02	2.91	2.88	3.82	3.70	3.73
Mean of E and K.........	1.835	1.73	1.695	2.42	2.31	2.325

The average of the mean times found in the above table, for the three trials of each brake, gives the average interval between the application of the brakes by the engineer's valve and an equivalent instantaneous full application of brakes upon the whole train. The chief value of this knowledge is found in the correction of the length of stops made in running tests where the train pipe pressure and the speed vary. Hitherto this information has been lacking, and such corrections as have been made in the past were based on approximation; and while sufficiently accurate for comparison where there are great differences in the length of stops and minor differences in speed, they are not as accurate as is desirable for accurate analysis.

The averages from Table F are for the Westinghouse train 1.75 sec., and for the New York 2.35 sec.

The following formula for the length of stops derived from these tests is undoubtedly the most accurate ever deduced and is based wholly on the facts obtained:

$$S = \frac{P_1 - 2}{68}\left[S_1 - 1.47tV_1\right]\frac{V^2}{V_1^2} + 1.47tV.$$

In this formula the letters represent the following quantities:

S = length of stop corrected to 70 lbs. T P pressure and speed V.

S_1 = the length of the stop in feet.

V = the basis of speed to which it is desired to reduce the stops.

V_1 = the speed in miles per hour.

P_1 = the train pipe pressure.

t = the average time elapsing from the movement of the engineer's handle to the instant of the equivalent full application of the brakes as is explained in the foregoing.

NOTE.—"t" varies with different systems of brakes and with different lengths of trains for the same system of brakes. The value of "t" now having been deter-

mined for 50-car trains of both the Westinghouse and New York brakes, we are in possession of a formula which permits very accurate reductions of the running tests to a uniform basis of speel, and therefore permits a more accurate comparison of stops in running tests than has been possible heretofore. The values of "t" for the different trains and conditions are given in Table G.

TABLE G OF VALUES OF $1.47t$ AND $1.47tV$.—FOR TRAINS USED IN ALBANY TESTS.

Train.	$1.47t$.	$1.47tV$.
Westinghouse	2.57	77.1
New York	3.45	103.5
Mixed—45 cars	2.85	85.5
Mixed—55 cars	3.24	97.2

Interlocking at Forty-third Street, Chicago—Illinois Central Railroad.

The National Switch & Signal Company, of Easton, Pa., is providing for the Illinois Central Railroad some large interlocking apparatus, as was noted in our issue of Feb. 10. A 92-lever machine for Twelfth street, at the entrance to the new station, is building, and an 80-lever machine for Forty-third street has been shipped. The latter machine has 77 working levers and three spare spaces, and will operate 52 switches, 7 movable frogs, 66 ocks and 37 signals. These switches and slips are provided with 2,700 ft. of detector bars. No selectors are used in this plant.

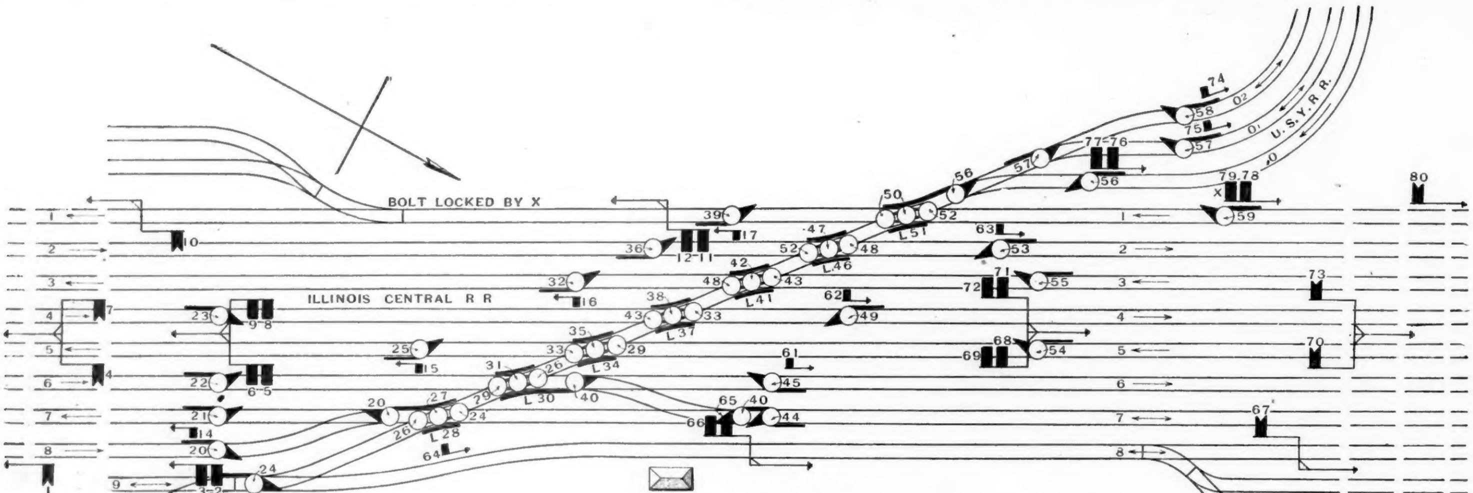


DIAGRAM OF SWITCHES AND SIGNALS AT FORTY-THIRD STREET, CHICAGO, ILL.

For the ILLINOIS CENTRAL RAILROAD *by the* NATIONAL SWITCH & SIGNAL COMPANY.

By examination of the plan of the layout it will be seen that the nine tracks are crossed by a straight crossing, having seven sets of No. 7 movable frogs and double slip switches, and that there are besides several single switches leading to the sidings. Each track except No. 8 has a derailing switch on each side of the crossing. These derailers are placed 300 ft. from the crossings in the running direction and 150 ft. in the reverse direction. The plant is well concentrated for so large a one; the greatest distance of any switch is 591 ft. from the tower, and the total connections required but 16,500 ft. of pipe and 64,000 ft. of wire. The tower is a frame structure 12 ft. 2 in. by 37 ft. 8 in.

The locking for the crossings is very heavy as may be illustrated by the following schedule of the locking of one lever, No. 13, which has the heaviest locking of any lever in the machine. The letter N following the number of each lever indicates that it is locked in its normal position; those not so indicated are locked in their reverse position:

Lever 13 locks 24 N or 24, (27 with 24 and 26); (28 with 24); (30 with 24 and 26); (31 with 24, 26, 29); (34 with 24, 26, 29); (35 with 24, 26, 29, 33); (37 with 24, 26, 29, 33); (38 with 24, 26, 29, 33, 43); (40 N with 24, 26 N); (40 N with 24, 26, 29 N); (41 with 24, 26, 29, 33, 43); (42 with 24, 26, 29, 33, 43, 48); (44 with 24, 26 N); (45 with 24, 26, 29 N); (46 with 24, 26, 29, 33, 43, 48); (47 with 24, 26, 29, 33, 43, 48, 52); (49 with 24, 26, 29, 33, 43 N); (51 with 24, 26, 29, 33, 43, 48, 52); (53 with 24, 26, 29, 33, 43, 48, 52 N); (54 with 24, 26, 29, 33 N); (55 with 24, 26, 29, 33, 43, 48 N); (56 N or 56 with 24, 26, 29, 33, 43, 48, 50, 52); (57 N or 57 with 24, 26, 29, 33, 43, 48, 50, 52, 56 N); (58 with 24, 26, 29, 33, 43, 48, 50, 52, 56 N 57 N); (59 with 24, 26, 29, 33, 43, 48, 50 N, 52); (61 N with 24, 26); (62 N with 24, 26, 29, 33); (63 N with 24, 26, 29, 33, 43, 48); (64 N); (65 N with 24); (68 N with 24, 26, 29); (71 N with 24, 26, 29, 33, 43); (74 N with 24, 26, 29, 33, 43, 48, 52); (75 N with 24, 26, 29, 33, 43, 48, 52); (76 N with 24, 26, 29, 33, 43, 48, 52); (78 N with 24, 26, 29, 33, 43, 48, 52).

While this is, as we have said, the heaviest locking on any lever in the frame, there are many others which have a great deal of locking. In our notes on the works of the National company, published Feb. 10, we mentioned the fact that in this machine the locking is done both on the front and on the back of the frame by hanging tappets from both ends of the rockers, and this, we are told, is the first machine to be built in the United States with the locking applied in that way. The arrangement is found convenient and economical of space where such heavy locking is required. There is a great deal of special locking to be done, and for this the Pfeil cylinder special lock is used, a description of which with illustrations follows. Before passing to that, it will be interesting to the student of interlocking to notice the lever movements required to pass one train, say from track 2 to track 9, which is as follows: 24, 26, 27, 28, 29, 31, 30, 33, 35, 34, 43, 38, 37, 48, 42, 41, 52, 47, 46, 50, 51, 58, 74; total levers, 23; it being understood that the levers must be reversed substantially in the order given above.

There are in all 142 routes for which signal can be given, and eight movements can be made at one time.

PFEIL'S NEW LOCKING.

The locking used on this machine is new and is the invention of Mr. George H. Pfeil, Chief Engineer of the National company. It can be used either with a disc, cylinder or ball, and besides being anti-friction adapts itself readily to special interlocking. A description follows.

In the old form of locking the slide was usually a rectangular section fitted between the transverse straight guides on the tappet and capable of rectilinear movement only. The consequence was that in practice the slides were very apt to cock and jam in their guides, thus rendering the action of the machine uncertain. Moving with friction and requiring considerable force to operate them, they, at times, jammed tight and completely blocked the machine. With the roller which is held loosely on the tappet, so that it is capable both of rotary movement on its axis and of movement crosswise of the tappet the operation of the lock is practically frictionless, so far as concerns the dogs and itself.

In prior arrangements the slides themselves have been notched to directly interlock with the dogs, and have thus constituted the means by which the locked tappets were restrained from movement. With the Pfeil locking the notches are in the tappets while the rollers or cylinders are simply the anti-friction intermediaries whereby the dogs are actuated to engage or leave the notches in the tappets.

The manner in which this locking is carried into effect will be understood by reference to the accompanying cuts. Fig 1 is a plan showing tappets, rollers and dogs in their normal position. Fig. 2 is a similar plan with tappets 1, 3 and 4 reversed. Fig. 3 is a section on line 3-3, Fig. 1. Fig. 4 is an edge elevation of one of the tappets. Fig. 5 is an end view of roller guide or yoke. Fig. 6 is a side view of dog D. Fig. 7 is a side view of dog D 2. The tappets are mounted and connected to the levers in the usual manner, and the locking bars are adapted to slide transversely of the tappets.

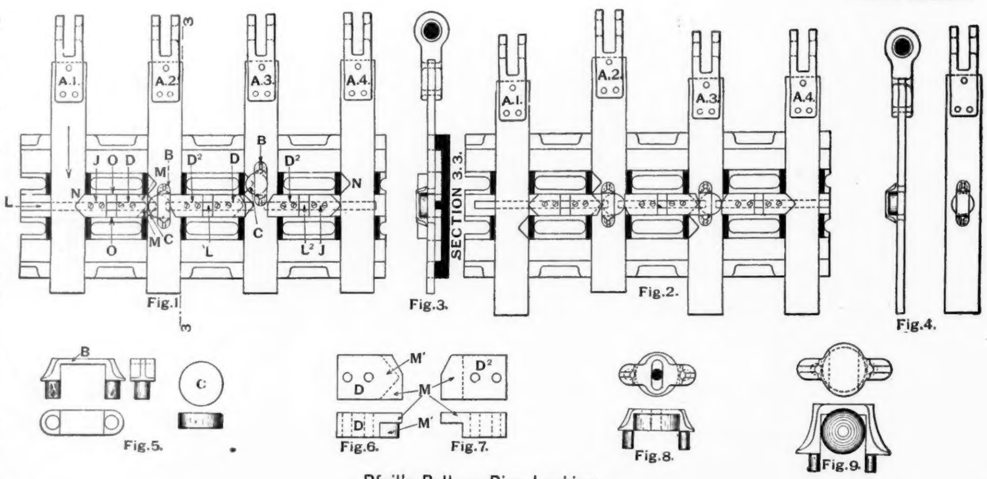
Upon the lock bar L are fixed the dogs J D, which are located between tappets A^1 and A^2, and like all the other dogs move in guides O in the frame. Upon the second lock bar L^1 are fixed the dogs D^2 and D, which are located between the tappets A^2 and A^3, and upon the third lock bar L^2 are fixed the dogs D^2 and J, which are located between the tappets A^3 and A^4. The dogs J are of the ordinary kind, having V or miter-shaped noses to engage similarly shaped notches N in the sides of the tappets.

There is one notch in the tappet A^1, two in tappet A^2, two in tappet A^3 and one in tappet A^4. In fig. 1 the notch in tappet A^1 is represented as engaged and filled by the dog J on lock bar L; the other dogs are out of engagement with the notches.

On each one of the tappets A^2 and A^3 is a cylinder C which is loosely placed in a guide yoke B, of the form shown in figs. 1 to 5 inclusive, the yoke B being fastened by its legs to tappet in a position to permit the cylinder to move bodily transversely of the tappet. This cylinder, in addition to this bodily movement, can also rotate on its axis, or, in other words, it can roll from side to side of the tappet. The dog D has an extension M to operate on the roller, and is provided below this extension with a miter nose M^1, to engage the miter notches on the adjoining edge of the tappet, with which it co-operates. The dog D^2 has a like extension M, for a like purpose, but it has no miter nose for the reason that in the particular arrangement shown in the illustration the edge of the tappet adjoining it is plain and unnotched.

The operation is as follows: In fig. 1 all of the tappets are normal, a position in which the cylinder C of tappet A^2 is in the path of the dogs and the cylinder on tappet A^3 is above the path and out of the range of the dogs, and the miter nose of the dog J of lock bar L is in engagement with the notch N of tappet A^1. All of the tappets in this position are unlocked. If now tappet A^1 be reversed (its movement for this purpose being in the direction of the arrow placed on it in fig. 1) it will push dog J and lock bar L to the right, and as dog D is attached also to the same lock bar L as dog J, it will lock tappet A^2 by its nose M^1, and at the same time by its extension M will push the cylinder C of tappet A^2 over against dog D^2 in lock bar L^1, and consequently will move the dog D of that lock bar. Also in this way the tappet A^3 is locked, but inasmuch as its cylinder C is out of range of the dogs no movement is communicated to lock bar L^2, and consequently the tappet A^4 is left unlocked and free to move.

By reference to fig. 2 it will be seen that A^2 normal, A^3 and A^4 reversed are locked by lever A^1 reversed. In all of these movements, as well as others of which the apparatus may be rendered capable, the cylinders transmit movement to the dogs with entire certainty. They are not liable to cramp or jam in their guide ways; any tendency to this is neutralized and prevented by their capacity to revolve, as well as to move bodily in a transverse direction, so that all danger of the blocking of the machine is obviated while there is great freedom from friction and consequent ease of manipulation. The arrangement shown in figs. 8 and 9 can be used in place of fig. 5.



Pfeil's Ball or Disc Locking.

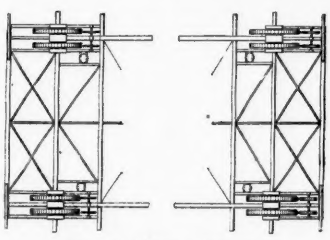
A Lift Bridge in Chicago.

In the *Railroad Gazette* of April 8, 1892, there appeared drawings and a description of a design for a lift bridge prepared by Mr. J. A. L. Waddell for the ship canal at Duluth. For various reasons the project of bridging that canal was abandoned at the time, but Mr. Waddell has recently applied the same idea to a bridge over the south fork of the Chicago River at South Halstead street, Chicago, and we show a general elevation of the structure and diagrams of the operating ropes. The contract for building this bridge was let to the Pittsburgh Bridge Company on Dec. 31, Mr. Waddell having prepared the plans and specifications for letting. There were several bidders, but the tender of the Pittsburgh company was the lowest on the basis of the total quantities assumed in the specifications. The Hale Elevator Company, of Chicago, took the contract for the operating machinery under a guarantee of successful operation.

The swing span at this point was so injured by a vessel that it had to be removed, and traffic over the river at that point has been suspended ever since, except that pedestrians cross on a pile foot bridge with a pontoon draw. The channel is narrow, and is still further reduced by a skew, and the shipping interests prevented the building of another swing bridge. The letting of the contract was considerably delayed by the War Department, until the city agreed to make the clear height 155 ft. instead of 140, as at first specified. The height of the lift of the proposed bridge at Duluth was 140 ft.

The span is 130 ft. between end pins, and crosses the river on a skew of about 67 deg. making the clear width between lines drawn through the pier corners parallel to the river about 90 ft.

The towers are about 200 ft. high above the water level, each one carrying at its top eight steel and iron pulleys 12 ft. in diameter, having 12 in. axles. Over these pulleys 32 steel wire ropes will pass. These ropes will be made into endless loops.* One end of each of these loops will be attached to an end pin of the truss, and the other end to a rocker supporting one of the sets of counterweights, which counterweights will be so proportioned as to just balance the dead weight of the span. The weight of the cables is counterbalanced by that of cast iron chains, one end of each of which is attached to the counterweights and the other to the bridge. The attachment of these chains to the counterweights is



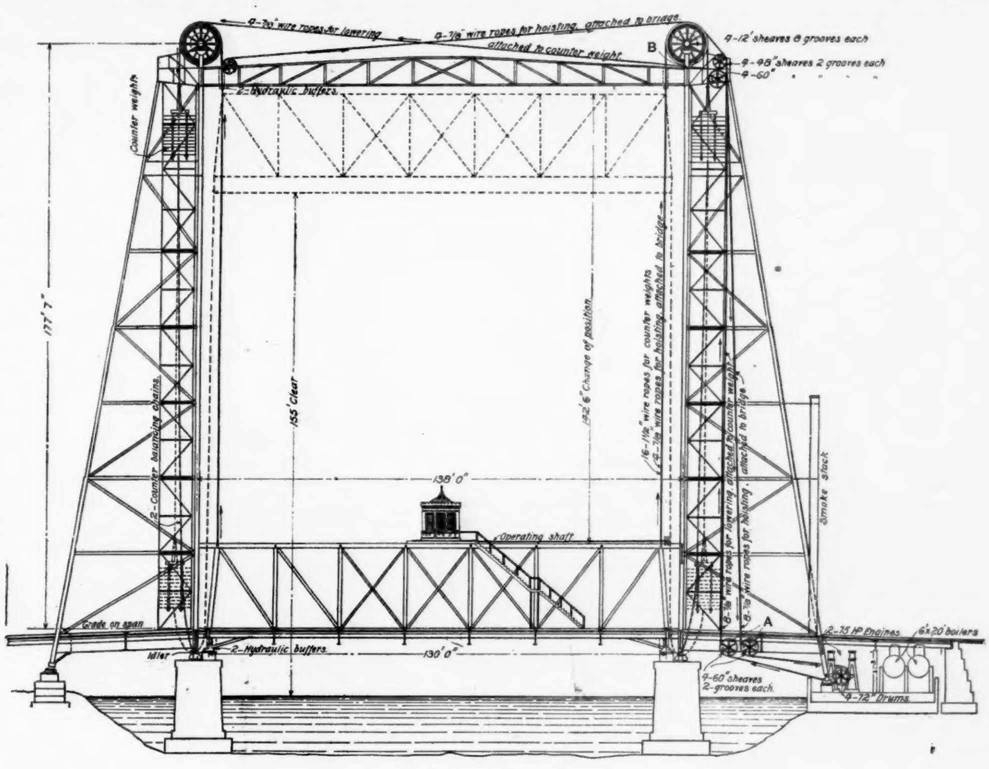
Plan of Upper Sheaves.

made in such a way as to distribute equally the weight of the chains over the various cables, even if the latter stretch unequally. To provide for settlement of the main piers there will be adjustments under the pedestals of the rear columns of the towers.

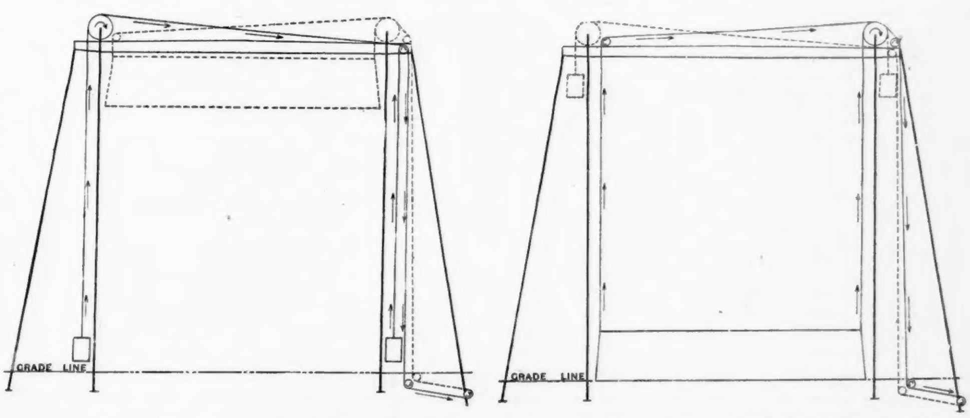
On account of the counterbalancing all the work that the operating machinery will have to do will be to overcome the friction, inertia of the mass, and the varying dead weight of the bridge, due to occasional passengers, dirt, snow, water, etc. It is intended, however, that the bridge shall at all times be kept as free as practicable from dirt and snow, and the other varying loads will be compensated by tanks containing water, reducing the labor of making the adjustment to a minimum. These tanks are all connected by pipes in order to distribute the weight of water equally to the four corners of the span, where the supporting ropes take hold. Of course this method necessitates the overweighting of the counterweights, but the increased expense is not great. Although it is not contemplated to permit any one except the bridge tender to remain on the bridge when it is being raised, nevertheless the machinery will have to be capable of lifting at least a ton weight of passengers without reducing the speed below that specified or overstraining any of its parts.

The power of the engines will be communicated to a shaft, to which are keyed two six foot drums, having spiral grooves for winding the steel wire rope cables, each of which is fastened at one end to the bridge or to a counterweight and at the other end to one of the drums. These ropes are kept taut at all times by adjusting rods. By turning the operating drums in one direction the bridge will ascend and by turning them in the other direction it will descend. In case of accident to the machinery the span can be raised and lowered slowly by hand power. The approximate weight to be lifted is 550,000 lbs., consequently that of the counterweights must be also 550,000 lbs. As the weight of the wire cables and the cast-iron counterbalancing chains is about 40,000 lbs., the total moving weight will be about 1,140,000 lbs. At the top and bottom of the towers there

* In the final plans the loops contemplated for the main cables have been discarded and replaced by a detail that attaches the two ends of each main cable to a special pin above the end of the top chord.



General Elevation.



No ropes shown here except those for lowering the bridge. *No ropes shown here except those for lifting the bridge.*

Diagrams of Operating Ropes.

HALSTED STREET LIFT BRIDGE, CHICAGO, ILL.

Mr. J. A. L. WADDELL, Designer and Engineer.

will be hydraulic buffers capable of bringing the structure to rest from its maximum velocity without injurious shock. After the bridge is down it will be held in place by relieving the counterweights to the full extent of the capacity of one engine. The bridge will be steadied while in motion by rollers at the top and bottom, pressing against the flush surfaces of the main columns and providing against excessive friction from both transverse and longitudinal wind pressure. With no wind pressure acting, the rollers for transverse wind loading do not touch the columns, but those for longitudinal wind loading touch the columns at all times, being pressed against them by springs. This detail is necessitated by the contraction and expansion of the trusses.

The bridge is designed to carry wagons and street cars between trusses and pedestrians outside. The distance between central planes of trusses will be 40 ft. and the width of bridge from centre to centre of exterior hand rails about 57 ft. The depth of truss will be 23 ft. The live load used in the calculations is 4,500 lbs. per lineal foot and the dead load 4,000 lbs. per lineal ft. The steel stringers are proportioned for a central loading of 11 tons uniformly distributed over a roller length of six feet. The remainder of the metal work is proportioned for a live load of 100 lbs. per square foot. The assumed wind pressure is 30 lbs. per square foot on the exposed surfaces of the structure, including both trusses and towers.

Each tower will consist of two main columns and two rear columns with bracing on all four faces. Near the top of each tower are two girders to support a temporary timber platform, which will carry the counterweights until the bridge is swung, and which will serve afterward to support these weights when the main cables are being repaired. The counterweights will consist of masses of cast iron about 10 in. wide, 12 in. high, and nine feet long, strung on wrought iron rods that attach by rockers to the cables above.

Borings made lately show the bed rock to be about 9 ft. nearer the surface than was first assumed, and that most of the overlying material is semi-fluid in character and therefore unfit to hold piles, consequently the main piers first specified have been replaced by two solitary piers which rest on pneumatic caissons 18 ft. square. The load is thus carried directly to the bed rock and the danger of unequal settlement or lateral displacement of piers is reduced to zero.

The engines are required to have a capacity to lift the bridge to a clear height of 100 ft. in 50 seconds, using one engine only, the other to be held in reserve. It is required, however, that the second engine shall be capable of being thrown into action from the operating house instantly. It was Mr. Waddell's preference to use electric motors for operating the bridge, but the contractors for the machinery preferred to put in steam. Adequate apparatus is provided for working the bridge by hand in case of a breakdown of the machinery, and a complete modern outfit for signaling is also provided for, as well as a special peeper designed and patented by Mr. Waddell and placed in the operating house. The function of this peeper is to determine whether or not the bridge is lifted high enough to clear the masts of an approaching vessel.

There are eight operating ropes for raising the bridge and eight for lowering it. These are ⅞ in. in diameter and adjusted by rods. The sustaining ropes are 1½ in. in diameter, and of these there are 32; that is, eight at each corner of the bridge. The weight of the bridge is to be counterbalanced by weights and chains as indicated in the illustration. The hydraulic buffers are to have a capacity to bring the bridge to rest without shock from a speed of 4 ft. a second, which is to be the greatest speed allowed by the automatic governors.

The claims made by Mr. Waddell as to the special advantages of this design are summed up below. A lift bridge gives a large single channel instead of the two smaller channels afforded by a rotating draw. There are no land damages for the reason that the entire structure can be built within the limits of the street. Vessels are run up close and use the docks in the immediate vicinity, which they cannot do in the case of a rotating draw. The operating mechanism of a lift-bridge is very simple and there is nothing likely to get

out of order, consequently there will be no danger that the bridge will not work when a vessel is ready to to pass through. Even if the entire machinery were to break down the bridge can be lifted out of the way in a short time by man power, aided by the drawing off of the water in the ballast tanks, whereby an unbalanced force is brought into play, tending to raise the bridge. To bring the structure down again without the aid of the machinery, water would be pumped to the top of one of the towers and thence into the ballast tanks. The only parts of the structure that would cause a stoppage of the working of the bridge by breaking down are the big wheels at the tops of the towers and the counterbalancing cables. In respect to the former they are made very large and strong, and the pressure on their bearings is less than 600 lbs. per square inch. Said bearings are to be lubricated by graphite as well as oil, so there is no chance of their running dry. As for the counterbalance cables, these are designed with a factor of safety of twelve instead of the usual factor of five consequently there is no chance of their ever failing. Moreover, the sheaves over which they run are so large that the amount of wear on the cables is extremely small; therefore they would not have to be replaced for a number of years. The stretching of these cables is provided for by a self compensating detail that takes care also of any unequal stretching of the various ropes. The lift-bridge will be held down not by any locking apparatus, which by getting out of order might interfere with quick working of the structure, but by simply lifting on the counter-weights with the full capacity of either one or both engines, thus throwing a pressure on the pedestals that will prevent any tendency to bump the bridge on the piers by reason of vibration caused by passing vehicles. It is not improbable, though, that in the case of a lift-bridge to carry railroad trains some kind of locking gear would be found necessary.

Some of the advantages are shared by the bascule and folding or jack-knife bridges, but the lift-bridge has several points of superiority over both these types, which are important enough to warrant its being adopted in preference to them, even at a much greater expenditure of money.

It is impracticable to put a pavement on either a bascule or folding bridge. The bascule bridge, to be rigid and in every way satisfactory, should have both ends of span resting on piers when carrying load, thus necessitating a central pier or a very long span. A double bascule with cantilever arms or a middle connection to make the two spans continuous would not be found to work satisfactorily because of want of rigidity in the first case and awkward and unsatisfactory adjustments in the second case. The bascule bridge when raised to full height could not readily be lowered were a strong wind blowing against the under side of the floor. The effect of a heavy load on one side of either a folding bridge or bascule bridge, with spans unsupported by piers at one end, is to cause injurious torsion on the structure, which would be a serious matter in case of a railroad bridge. The loosejointedness of a folding bridge would cause serious vibrations in the case of rapidly moving heavy loads. The lift-bridge can be built of any length of span, width, capacity, strength or rigidity required; and can be raised to any reasonable height, enough in any case to permit the unobstructed passage of the highest masted vessel ever built.

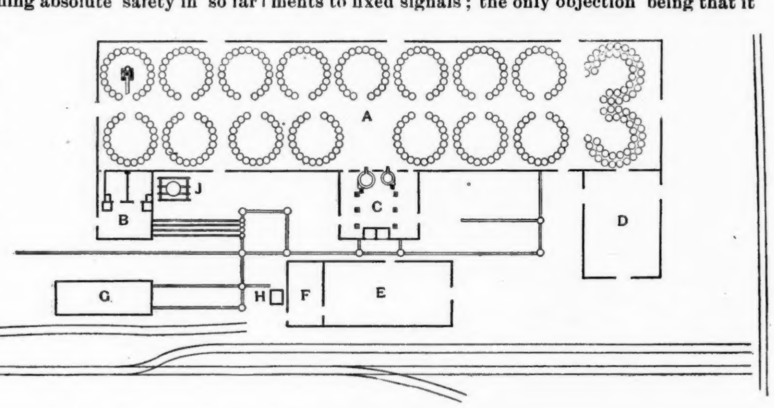
The Car Wheel Foundry at Carteret.

The Canda Manufacturing Company, organized under the laws of New Jersey, with offices at 11 Pine street, New York, purchased about two years ago a tract of about 1,000 acres of land on the Long Branch Division of the Central Railroad of New Jersey, about midway between Elizabethport and Perth Amboy, which is now being developed as a town site, and especially as a location for manufacturing. The situation is an advantageous one for both rail and water communication, having a large deep water frontage on the Arthur Kill or Staten Island Sound. The name of the place, "Carteret," was selected on account of interesting historical associations. At this place the company is now building, and has nearly completed, extensive car works, and other concerns are building and preparing to build works of other kinds. All of this matter we shall treat at length in another article very soon. The purpose of this article is simply to mention the car wheel works which have been in successful operation there for a year past.

These works have a capacity at present of 300 wheels a day, which can be easily increased to 450 wheels. The general plan of the works is shown in the accompanying engraving. The railroad tracks which are shown connect with the Central Railroad of New Jersey and also with the extensive system of tracks that the company has just put in for the service of its car works and dock. The ground plan of the casting room is shown at *A* where the arrangement of the molding floors and annealing pits may be seen. These pits are served by steam cranes while the molding floors are operated by hydraulic cranes, one of which is indicated in the upper left hand corner of *A*. The material is handled through the foundry by trolleys running longitudinally overhead. At *C* are two Victor Colliau cupolas. Material is delivered to these cupolas by the narrow gauge tracks, which with their turntable are indicated in the engraving. It will be seen that this system of tracks communicates with all parts of the yards in which material is stored. The metal loaded on small cars is weighed on track scales and delivered to elevators shown at *C*, then hoisted to the second floor and run off ready for charging the cupolas. The core ovens are at *B*.

D is the cleaning room; in this room are stationed two of the Ensign car wheel grinding machines, which were illustrated and described in our issue of June 10, 1892. This machine was invented by Mr. I. R. Titus, Superintendent of the gray iron foundry of the Ensign Manufacturing Company, at Huntington, W. Va., where it has been used for about three years, and it is a very ingenious and efficient tool. One hundred and eighty wheels a day can easily be ground on it, one man operating it, and from 200 to 225 can be ground if required. In this room also are the appliances for testing wheels, including a new and ingenious automatic friction geared drop, also designed by Mr. Titus. At *E* and *F* are shown the engine room and machine shop, the second floor of which is the pattern shop. The machine shop is equipped with the latest improved tools for boring and fitting wheels on axles. At *H* is the drop for breaking wheels.

In these works the Canda contracting chill is used, which is the invention of Mr. F. E. Canda, the Vice-President of the company, and was illustrated and described in our issue of March 25, 1892. This chill has been used exclusively at the Huntington works for a long time, and all the wheels cast at Carteret are made in it. For a description of it the reader is referred to the article indicated above. It is enough to say that it is a very excellent example of the contracting type of chill, the advantages of which are now generally known and admitted. The chill surface being segmental, small fins are left on the tread of the wheels which are ground off by the grinding machine already mentioned. The general dimensions of the works are indicated in the legend under the cut.



Wheel Foundry—Canda Manufacturing Company.

A, wheel foundry, 74 ft. × 130 ft.; *B*, core-room, 33 ft. × 40 ft.; *C*, cupola room, 40 ft. × 45 ft.; *D*, cleaning-room, 44 ft. × 42 ft.; *E* and *F*, engine room and boiler room, 40 ft. × 97 ft.; *G*, coke shed, 20 ft. × 90 ft.; *H*, drop; *J*, water tank.

The National Repeating Torpedo Signal.

BY J. W. LATTIG.

Whatever else may be said in relation to railroad signaling, or whatever differences of opinion may exist among those best qualified to judge as to the most effective means of obtaining absolute safety in so far as signaling can promote that end, it can be said without fear of contravention that there are at least three things which ought invariably to be kept in mind, and no signal, system or device should be employed which cannot bear the scrutiny of an examination with these requirements in view, or so many of them at least as may be concerned and appropriate to the signal, system or device under investigation.

They are:—(1) That the right 'road' should be 'made, and 'kept' for an approaching train, (2) that the right signal should be unmistakably given, and (3) *that the signal should be obeyed.*

The purpose of this article is not to deal with the first two of these propositions, for with the abundant means devised by the many bright minds in the signal business, and which have been introduced by the various signal companies, it seems that there remains but little to be done in either of these directions except to promote a more general adoption of the same by the railroads. With the latter. "*that the signal should be obeyed,*" I have now to deal.

With this object in mind, many efforts, some of them of very early date, have been made to supplement visible signals by audible and other devices, and these additional safety supplements are naturally divided into several classes: (1) Those that merely supplement; (2) those that supplement and leave a record if disobeyed upon which record the disobedient engineer knows he will be held strictly accountable; (3) and those that attempt to perform a part of the functions of the engineer by shutting off the supply of steam or by applying the brakes.

These efforts were not entirely due to a desire to protect traffic against careless engineers, of which class, unfortunately, there are still a few left. Other reasons may be assigned which are equally strong in favor of these supplementary additions to signals. For example, a blinding snow or rain storm, or a thick fog may obscure the vision of an engineer and mislead him as to his exact location, so that the rule that a train must not pass a signal until its position is absolutely known to be at safety will not apply; or an engineer may have his attention attracted to some other duty just about the time he passes a flagman or signal, or he may even be asleep as has, unfortunately, already happened, and in this or some similar way pass a signal at danger which he failed to see, but which might have been forced upon his attention by some such additional attachment to the ordinary signal. An engineer may close his eyes or turn his head, but he cannot thereby affect his hearing. It was these considerations which led to the efforts mentioned.

The first attempt to add an audible supplement to a fixed signal of which I am able to find a record is represented by fig. 6, and is of the kind which falls under the first class mentioned, the idea being to act upon the whistle of the engine. Its application is as follows: A rigid or elastic inclined plane is placed at the point at which it is desired to give an audible signal and is so arranged that when the signal that it supplements is at danger, the inclined plane is elevated into the path of an up and down rod which is attached to the whistle of each engine and this rod will engage with the inclined plane, raising the rod and sounding the whistle if the point be passed while the signal is at danger. When the signal is restored to safety, the inclined plane is removed entirely from the path of the rod and no audible signal will then be received. The difficulty with this system is that not only every engine of the road equipped must be furnished with these rods, but also every engine of any other road running over the same tracks. Another and perhaps the most serious difficulty is that the nature of the device is such that no indication of its being out of order is given until the device has failed, and such a failure may easily result from the breaking or bending of the rod by coming in contact, without the knowledge of the engineer, with some other object than the inclined plane and that perhaps a few minutes after inspection, when he has every reason to believe it to be in working order. Electrical and other means have also been tried, but the same objections attach to all such methods of which I have thus far had knowledge.

Of the same class are the detonating signals or caps which have become such a valuable adjunct, if not an absolute necessity, to railroad signaling, especially for the use of flagmen. Experience has demonstrated the extreme utility of these detonating signals as supplements to fixed signals; the only objection being that it would be prohibitively expensive on most roads to station a signalman at every fixed signal to place and displace caps on the rail each time the signal goes to danger or safety, as is being done in some countries and as was done in the Fourth Avenue tunnel of the New York Central road for several months, until the expensive necessity was obviated by the introduction of the National Switch & Signal Company's repeating torpedo signal.

Of the third class little can as yet be said, except that all of the objections to those of the first class seem to inherently exist therein; but there has been so little done in that direction, probably because of these difficulties, that it seems useless to criticise a device not yet justified by experience.

It seems, therefore, that supplemental devices of the second class, namely, those that supplement and record, will best meet the requirements, provided they have stood the test of long continued practical use and have not been found wanting. The National repeating torpedo signal is of this class and seems to fill the need more fully than any other device known. It has been used for a number of years on the Manhattan Elevated in New York, where it is said there is one machine which moves, placing and displacing torpedoes, about 5,000 times every day with the most absolute certainty and satisfaction.

There are also 12 of these machines in use in the Fourth Avenue tunnel of the New York Central Railroad in New York, where they have been subjected to a most thorough and satisfactory test for months past under the most trying conditions it is perhaps possible to find. They are also in use on the Lehigh Valley Railroad and on a number of Western roads in some states where the law requires both derails and audible signals for grade crossings.

On some roads where an engineer overruns a danger signal and can show no justification for so doing, he is

suspended for the first and discharged for the second offense. The exploded torpedo is the record which makes it impossible for him to hide his failure to *obey* the signal.

The object of this machine is to place and displace torpedoes automatically in such relation to the rails and wheels of a train that the torpedo will be placed and exploded if the signal be at danger upon the passage of a train, or displaced and removed from all danger of explosion if the signal be at safety. At the same time the torpedoes are always protected from exposure to the weather or accessibility to persons who might be disposed to remove or injure them, either when placed for exploding or when in the magazine, which latter may be provided with a lock if desired. Fig. 1 is an elevation of the machine. Fig. 2 is a longitudinal vertical section through the centre. Fig. 3 is a vertical cross-section through the line *A B* of fig. 1. Fig. 4 is an elevation of lifter *C* and torpedo slide *D* of fig. 2. Fig. 5 is a plan of the same together with sections of *D*.

Referring to figs. 1, 2 and 3, *E* is a hanger provided at the end next to the rail with large flanges *F* for the purpose of bolting to the rail by means of clips *G* and *H* fig. 1. At the end nearest the rail hanger *E* is cored out forming a cavity *I*, larger at the top than at the bottom. In this opening is placed a heavy spring *J* which seats itself on the shoulder formed by the reduced opening at the bottom, and is supported and kept in position vertically by the walls of the cavity. The anvil casting *K* is placed upon the top of this spring and the spring is compressed until the projections *L* and *L'* on the anvil casting *K*, fig. 3, can be entered under the ears *M* and *M'* on the flange *F* of hanger *E*, fig. 3. The anvil casting *K* is provided at its back end with two downwardly projecting pieces *N*, one of which fits over either side of hanger *E*. The hanger and the projections have holes through them as shown and are thereby bolted or pinned together. The hole in the hanger *E* is never drilled until the machine is fitted to the rail upon which it is to be used, the object of which is to suitably adjust the distance between the top of the machine and the side of the rail. It will therefore be seen that the hanger *E* and the anvil casting *K* are by this means joined together in such a manner that the upward movement of the anvil *K* is limited by the contact between the extensions *L* and *L'* thereon and the ears *M* and *M'* on the flange *F* on hanger *E*, but it will be noticed that the anvil casting *K* can be depressed, revolving on the pin at its back end, until it comes in contact with the lower portion of the hanger *E* at points *O* and *O'*. The object of the spring *J* and the provision for movement of the anvil casting *K* between the points *M* and *M'* and *O* and *O'* is to prevent breakage of parts by wheels which have been worn more than those for which the machine has been adjusted. In case such a wheel strikes an exploder and depresses it more than enough to explode the torpedo, the spring *J* yields and prevents crushing of parts. The tension of spring *J* is, however, sufficiently strong to explode torpedoes without yielding any appreciable amount.

The details of the torpedo slide *D*, figs. 4 and 5, which is placed on top of the anvil *K*, are as follows: At its back end it is provided with a suitable jaw for the purpose of attaching it to the connecting rod to which the operating attachment is made; on the top and at the outside edges of its opposite end, it has four inclined surfaces *P* for the lifter roller *Q* to roll up and down upon. In the centre of its right hand end, plan view, there is an annular opening *R*, the right extremity of which is cut away leaving two prongs *S* and *S'*, the opening between which is smaller than the diameter of the circle. The size of these parts is such that a torpedo exactly fits into the opening and cannot slip between the prongs so long as the torpedo is intact. The under side of this slide is cut away as shown by dotted lines *T* and by cross-section of that end. By this construction, that is, the opening between the prongs, and by the metal being cut away under the slide, the fragments of shells of exploded torpedoes are afforded ample means of escape and are not therefore drawn back into the machine when the slide is moved back. The lifters *C* are pivoted at their back ends as shown; and when the slide *D* is moved forward, the inclined planes thereon pass into the path of the rollers *Q* on the lifters *C*. This movement raises the lifters at their right hand ends, which raises the exploder *U* and prepares it to receive beneath it one of the torpedoes which has been carried forward from the magazine *V*. When the slide is fully forward it will be noticed that the torpedo *W* is directly under the exploder and that the inclined planes have passed beyond the path of the lifter rollers *Q*. If any train attempts to pass the instrument while in this position, the first wheel thereof will explode the torpedo. When the slide is again withdrawn, the opening *R* comes directly under the magazine, which holds five torpedoes. A new torpedo immediately drops within the opening and is carried forward and placed beneath the exploder the next time the signal is placed at danger. Within the exploder *U* will be noticed a spring *X* and a slotted opening in which a pin *Y* can travel vertically. The object of this spring and slot is to prevent breaking, crushing or bending of any of the parts should the machine be operated while a train is passing, or should a wheel strike the exploder just at the instant that the lifter rollers are passing over the elevated portions of torpedo slide *D* between the inclined surfaces *PP* thereon. In this event the spring is compressed as the exploder is depressed, and the pin *Y* finds a clear space in the slot above it. The spring *X* restores the apparatus to normal as soon as such pressure is removed.

The machine is clamped to the rail by means of bolts *Z* and is vertically adjustable by set screws *Z'* as shown in figs. 1 and 3. The machine being longitudinally adjustable, as before described, it can be fitted with great nicety to any size of rail. In practice the machine is provided with a cam movement which insures exactness of throw, so that the opening *R* in the torpedo slide will be exactly under the exploder when in its forward position, corresponding with the danger position of the signal, and will be exactly under the magazine when withdrawn to its backward limit, corresponding with the signal when at safety. If not exploded by a passing train, the torpedo will be passed backward under the magazine and forward under the exploder as many times as the signal is changed from danger to safety, and *vice versa*. If the torpedo be exploded, a new one from the magazine will take its place the next time the signal be moved to safety; and this will continue as long as there be torpedoes in the magazine.

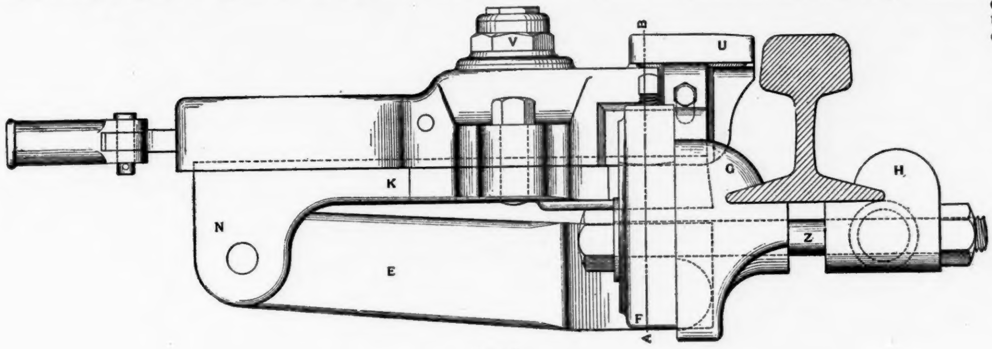


Fig. 1.

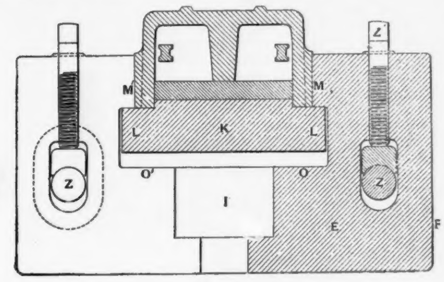


Fig. 3.

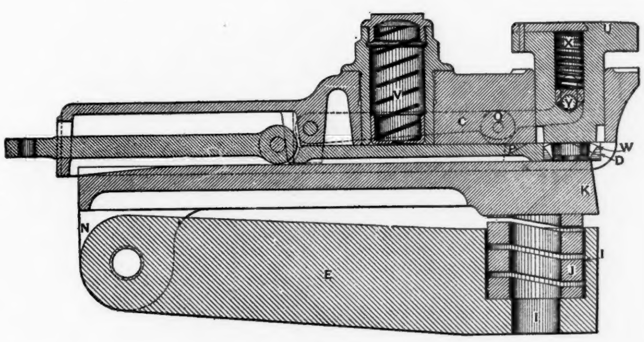


Fig. 2.

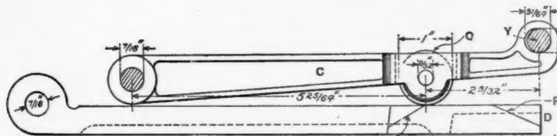


Fig. 4.

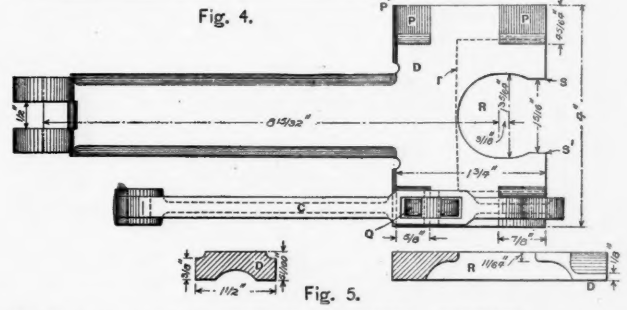
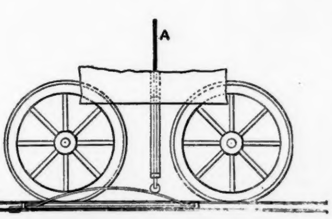


Fig. 5.

IMPROVED REPEATING TORPEDO SIGNAL—NATIONAL SWITCH & SIGNAL COMPANY.



A. Rod to Whistle of Engine.

Fig. 6—Old Style Audible Signal.

Some Thoughts on Boiler Inspection.*

The simple words "boiler inspection" may be considered as meaning but very little, or they can be regarded as encompassing a great deal. In its simplest form, the duty of a boiler inspector may be performed by the ordinary boilermaker, who, by a hasty glance, only observes the conditions of exposed surfaces and passes rapidly all parts not showing considerable irregularity of surface or having the appearance of leaks. On the other hand it may be said that the proper fulfillment of boiler inspection is far-reaching; that such duties should commence with the manufacture of the plate; that it should include the tests which boiler plate is necessarily subjected to; that such inspection should guide and assist in reaching designs intended to meet certain demands and requirements under well established conditions. Inspection should establish and conduct the tests which a complete boiler is required to undergo; it should outline the character of the test power, decide how long such test should be maintained, and what to be observed during the operation. Inspection duties lead on to the boiler in service, where it must institute the most critical examination as to how the several parts are performing required duty; must direct special attention to the extent of deterioration in part or as a whole; and finally pass on the methods pursued by persons charged with its care and management. Briefly stated, then, boiler inspection should commence with the manufacture of the boiler plate, pass successively on its strength and endurance, on the design and construction, on the manner of conducting and treatment in testing, observe its performance in service, establish periodical testing and institute the most intelligent methods for its care and management.

Passing to the design and construction of a boiler, both of which should be under the eye and subject to the advice of the experienced inspector, at this point it may be proper to call attention to the fact that of all structures we are called on to design, those of boiler dimensions in details are the most important.

The boiler, with its relative parts, is the most important part of the locomotive. On its power to meet necessary requirements depends to a great extent the economy and efficiency of our lines of transportation. There are some grounds for the belief that if the design and dimensions of locomotive boilers were given thought to as great a degree as that directed to improving the compound principle in locomotive engines, the result would be much more satisfactory in the direction of both economy and efficiency.

In all parts of boiler erection the inspector should play a ruling part and should be granted the greatest freedom in reaching conclusions as to the character of the work performed. There is scarcely a doubt that the strength and quality of boiler plate are often overtaxed and unduly strained while in the hands of a boilermaker. The plates have to undergo the various processes of heating, and cooling, hammering hot and cold, bending, twisting, flanging and punching, to say nothing of the evil of the draft pin or of hidden defects which are likely to occur in the plate.

There is certainly a possibility of bad and careless riveting, plates overheated in flanging, or cracked, if only slightly, in bending, and many other defects, which may be traced to want of skill or reckless negligence on the part of the workmen.

It is clearly evident that the material for a boiler may

* Paper read by John Hickey, Superintendent of Motive Power Northern Pacific Railroad, before the Northwest Railroad Club, Feb. 14, 1893.

be of the most superior quality sanctioned by use, and yet, if not skillfully handled and most carefully attended to during the process of preparation to take its place in the completed boiler, it may be reduced to a point less in strength and endurance than material of the most inferior grade. . . .

Opinions differ as to the best means of applying pressure in order to ascertain the strength of a boiler. Some advocate the hydraulic, others the steam, test. In favor of testing by steam, it is urged that it is the only means by which the conditions of strain can possibly be the same as those under which the boiler is worked. No doubt this is in the main true, but as a matter of safety a steam test should only be applied after the strength of the boiler has been ascertained by the water test.

In making a full test of a boiler, new or old, before a pressure is applied, the various parts, particularly those suspected of weakness, should be measured and gauged and the results carefully noted. After the test pressure (which should not be more than 40 per cent. in excess of the working pressure) is maintained for some time, the measurements previously obtained should be checked, and any extension, changes of form, distortion, bulging, etc., carefully noted. Then again, after the pressure is released any changes in measurements that may have been found should be known, whether permanent or not; and it seems to the writer that right here is a highly important point, one that should receive the most serious thought, in that, if there be any permanent enlargement or distortion, even in the slightest degree, it should be thoroughly examined to decide whether it is due to the elastic limit of the material having been exceeded or to improper construction. In all cases where permanent set is discovered the test should be repeated again and again if necessary, in order to ascertain if the set becomes increased.

In whichever manner a boiler is tested too great care cannot be exercised in obtaining the exact amount of pressure applied. Gauges in general use are too apt to get out of order to be implicitly trusted when only a single gauge is used. It is therefore urged and recommended that in all cases of important boiler testing not less than two gauges be used, in order to establish to a certainty the exact pressure applied.

It may be remarked here that the test pressure should be maintained for some considerable time, say half an hour or more. The continued pressure has often been known to lead to the detection of weakness, when, if such pressure had not been maintained, the defect would have escaped unobserved. . . .

From this it would appear that all boilers when new, or newly repaired, should be tested first by hydraulic pressure, and after by steam, the latter to determine what, if any, unequal expansion exists, to what extent, and what results have been produced.

The wear and tear of a boiler in service is an important feature for the inspector to keep in mind. From the hour the boiler is set at work it is acted upon by destroying forces, and many of them are almost uncontrollable in their work of deterioration. Internal corrosion is the malady that most boilers suffer from. Corrosion presents itself in various forms. Sometimes it happens that it is mainly the transverse seams, rivet heads and plate edges that are attacked; in other cases it is the longitudinal seams alone.

The stays are often more violently attacked and more rapidly wasted than the plates. A threaded stay will be attacked at the thread, while the unbroken or unturned surfaces will escape.

The body of a plate away from any disturbing influence is often attacked by furrowing and pitting, and in consequence of this apparent weakness has often been condemned and removed. The writer has seen plates removed from this cause when, although corrosion had taken place to some extent, there was left much more metal, and consequent strength than were possessed by the next section of the plate through the rivet holes. This is an expensive mistake, and inspectors ought to guard against it. . . .

Much is lost by improper care and unintelligent management of boilers in service. It seems unnecessary to remark that the management and care of boilers should be treated with as great a degree of intelligence as their design and construction. Excellent points to avoid are sudden and unequal expansion and contraction as a whole or in part. Blowing out a boiler while hot and washing it out with cold or comparatively cold water immediately thereafter is one of the most destructive and expensive practices of the service. Rapid and forced firing in a boiler which has been out of service and permitted to cool is also a boiler evil of the highest order. Permitting the entrance of cold air through the door or dampers immediately following the dumping of the fire is on a par with the worst evils, and its result is always apparent by the development of leaks.

To the correction of such distributing elements as the above, together with numerous abuses in the care of boilers, it is desired to direct the attention of inspectors, but the extent of correction will depend largely on the intelligence and common sense of the persons charged with inspectors' duties. It is readily seen that on the proper fulfillment of boiler inspection depends much public comfort, public expenditure and safety to public life and property. To perform the duties of boiler inspectors conscientiously and well the position can be no sinecure, and it can only be successful with the aid of experience in boiler design, construction and requirements, together with a full understanding of the direction in which the forces are applied while in service, as well as under the stresses of test. . . .

It is apparent that the office of supervisors of boilers is an indispensable adjunct to the mechanical department of railways. The design, construction and management of boilers are deserving of the most through and scientific study, and it is only by organizing especially for the purpose that the subject is certain to receive due attention and necessary thought.

It is thought best to suggest further that it is the bounden duty of all persons charged with the care and maintenance of steam boilers to highly encourage any steps toward the manufacture of an improved grade of boiler material and to support all efforts toward a higher order of intelligence in the arts of boiler design, boiler construction and boiler management.

High-Speed Car Boring Machine.

The vertical car boring machine illustrated, the designers claim, has new and original features, which make it much superior to this style of machine heretofore built.

Owing to its spiral form, a boring bit when revolving is unbalanced. At ordinary rates of speed, the point of the long bit describes a circle, making it hard to accurately strike a mark, and the tendency is to bore the hole out of line. This machine has the novel feature of a bit-steadying device, which allows about 50 per cent. higher speed, which gives an increased output in a given time and prevents delay in striking the mark, bending the bit, and boring out of line.

It will be seen from the general view of the machine, fig. 2, that the bit is steadied as near the work as is possible without obstructing the operator's view of the work. The bit-steadying device is shown in detail in fig. 3.

Heretofore all car-boring machines change the position of the spindles by screws operated by hand or by power. On this new machine the builders have introduced a quick-adjusting device which does away with complicated mechanism and makes the operation of adjusting the spindles very easy and quick. The adjusting levers are within easy reach of the operator and the spindles are easily and quickly thrown to position by hand levers and locked on the graduating arc by merely releasing pressure on the auxiliary handle. A detail of the quick-adjusting device is shown in fig. 4.

This machine has an automatic belt tightener, an extra long table, an extra clamp and other features which the designers, Messrs. Greenlee Bros. & Co., Chicago, Ill., claim to be valuable points of merit.

The Reading in the Hands of Receivers.

On Friday last the stock of the Philadelphia & Reading Railroad suddenly began to be sold in the New York stock markets at such low rates that there ensued a regular panic, so far as this stock was concerned. More than 400,000 shares (par value $50) changed hands in Wall street on that day and the excitement continued on Saturday and Monday. The price, which on Friday was about 47 per cent., had fallen on Monday to 28, and on that day receivers were appointed. Philadelphia dispatches reported the officers of the road as saying that there was nothing in the affairs of the company justifying the enormous offerings of stock, and the only explanation was that "the McLeod pool had been forced by its bankers to sell out its Reading stock." The common stock of the Reading amounts to about 40 millions, the mortgage bonds to 137½ millions and the other liabilities, according to the last report in Poor's Manual, 16 millions. A large share of this capitalization represents coal lands and old burdens, the length of road controlled by the company being less than 1,200 miles. The earnings of the railroad company for the last five years have averaged about 20 million dollars a year.

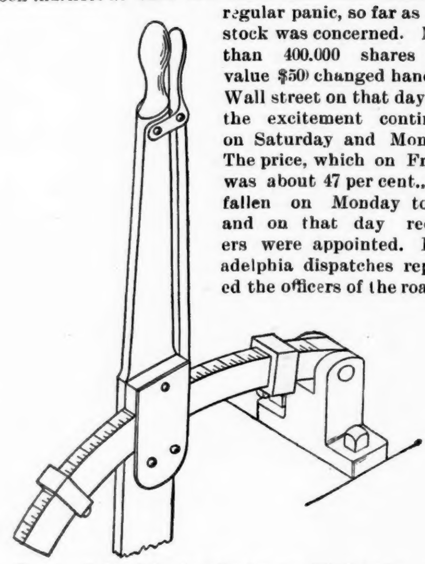


Fig. 4—Quick-Adjusting Device for Bit Spindle.

We print below a sketch of the affairs of the road, leading up to the present crisis, taken principally from the New York *Sun* of Tuesday:

For the third time in 13 years the Philadelphia & Reading has passed from the control of its owners into the hands of receivers. The stockholders have enjoyed control of their property for only a very small part of this time. They were in possession during the year ending June, 1884, after a receivership of three years, and as the reorganization which followed the second receivership period of four years deprived them of voting power until Aug. 1, 1892, it will be seen that in the 13 years the stockholders have held but two elections that were anything more than pro forma proceedings.

The placing of the property in the hands of receivers yesterday was a great surprise to Wall street. The heavy selling of the company's stock on Friday and Saturday last was understood to be on account of the dissolution of a Philadelphia syndicate that acquired control of the property when the voting trust was dissolved. The syndicate, according to all accounts, consisted of President McLeod, Thomas Dolan, John Wanamaker, Messrs. Gibson, Sinnott, and a few other Philadelphia capitalists not so well known. One of the first steps of the syndicate as soon as it obtained possession of the property was to make an alliance with Frank Jones and his associates in the Boston & Maine. The basis of this deal was the purchase of 50,000 shares of Boston & Maine stock at $150 a share. They had already got control of the Poughkeepsie Bridge, and the road now called the Philadelphia, Reading & New England. The next step was the purchase of the control of the Connecticut River road, the stock of which, at 215, represented $5,500,000. To complete the connection with the parent system, control of the New York & New England was contemplated, and Mr. McLeod and his friends have insisted for some time past that they held an absolute majority of the stock of that company.

It is known that none of these purchases were made without the aid of money-lenders. As a matter of fact, a good deal of the Connecticut River stock was brought to this city, and offered as security for loans as soon as the Philadelphia syndicate bought it. The Boston & Maine property was financed in the same way, while the New York & New England stock, whatever the amount may be, is carried in brokers' offices in this city, Boston and Philadelphia.

The moment that Mr McLeod's ambitious plans were disclosed conservative financiers and railroad men predicted that he would come to grief either in carrying them out or soon after completion. The fulfillment of this prophecy began last week and was completed yesterday, when, at Philadelphia, on the application of

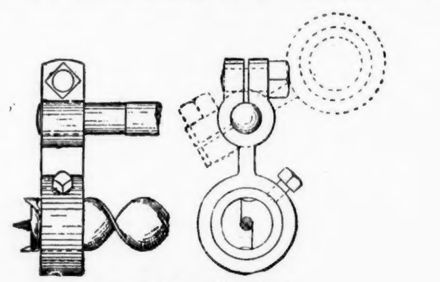


Fig. 3—Bit-Steadying Device.

Thomas C. Platt, the road was placed in the hands of three receivers, of whom Mr. McLeod is one. The others are President Wilbur of the Lehigh Valley, which is leased to the Reading, and Chief Justice Paxson of the Supreme Court of Pennsylvania. It is said that Judge Paxson will resign his judgeship. Mr. Platt's application stated that he could not get the interest on his income bonds.

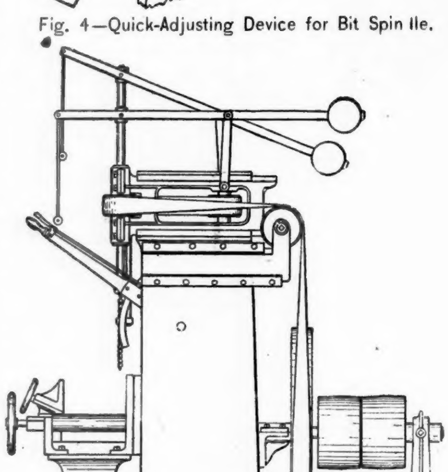


Fig. 1—End Elevation Showing Quick-Adjusting Device.

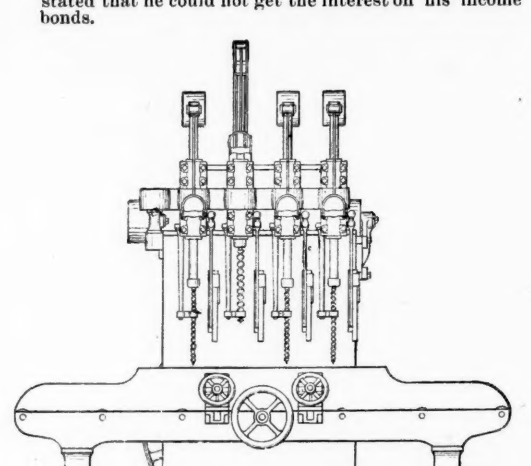


Fig. 2—Front Elevation Showing Bit-Steadying Device.

HIGH SPEED FOUR-SPINDLE VERTICAL BORING MACHINE.

Made by GREENLEE BROS. & CO, *Chicago.*

Until yesterday morning Wall street had no suspicion that the Reading company itself was in financial straits. The heavy selling of the stock on Friday and Saturday was generally regarded as having been sufficient to liquidate the Philadelphia pool, which, according to all accounts, has been carrying about 350,000 shares. It was known that Mr. McLeod and those interested with him had been engaged on business matters all day Sunday, and the street was prepared to find that they had mended their fences and would come into the market as buyers; but as soon as the Stock Exchange was open for business the furious selling of last week was resumed, and within the first few minutes the price dropped to 30. The transactions were unprecedented in the history of the Stock Exchange, for within the first hour over 40,000 shares, or more than half the capital stock of the company, had been traded in. In the whole day (Monday) the total transactions were 958,000 shares, or 158,000 shares more than the entire capital stock of the company. New England was naturally affected by the total collapse of the Reading, and dropped from 40 to 34½, but subsequently regained nearly all the ground it lost.

The report of the company's operations issued at the

annual meeting in January showed that the company had earned $3,100,000 after paying all fixed charges, or more than the interest on all three classes of its preference bonds. The interest was accordingly declared and was payable Feb. 1. However, to obtain the money to pay the interest President McLeod sold a block of the general mortgage bonds to Speyer & Co. and negotiated a loan with the same firm on another block, upon which he gave an option. In this way he raised $5,500,000. His explanation for not having in the treasury of the company the balance of net earnings for the year, shown by his statement to the security holders, was that the money had been used to conduct the coal business of the company, which had been largely increased during the year by the arrangement he had made to control the output of individual miners along the lines of the Reading system. The stockholders appeared to be satisfied with this explanation, and it was a natural supposition that the amount obtained from Speyer & Co. in excess of the amount required to pay interest on the preference bonds had put the company in easy circumstances financially.

It now appears that the company has not paid all of the interest upon its preference bonds, which indicates that it had more uses for money than the public had any idea of. If the company has been made a party to the efforts to control the Boston & Maine, the New York & New England, and other railroads east of the Hudson River, the complications growing out of the insolvency of the concern will unquestionably be serious. Mr. McLeod and his associates have insisted all along that these undertakings were entirely apart from the company, and that it could lose nothing if they did not turn out well, for the risk had been taken entirely by the syndicate.

The dealings in Reading bonds were proportionately as extensive as those in the stock. The aggregate sales of the various classes were about $5,000,000 par value. The general mortgage fours sold down to 77¼, and closed nearly four points lower than on Saturday at 78¼. The first preference bonds dropped from 60 to 50, but recovered to 55½, showing a net loss of 4½ per cent. The second preferences, after selling at 38, closed at 39½, as against 45 on Saturday, and the third preferences fell down to 28, and closed at 30½, as against 35 at the end of last week.

A remarkable feature of the excitement was the utter absence of rumors of failures on the Exchange or the embarrassment of any one engaged in the stock business. Reading has gone down about 20 per cent. within a week, the bonds have declined materially, and a number of other stocks have sustained large net declines, but as yet no weak spot has been uncovered.

Mr. McLeod's connection with the Reading dates back to 1887, when he was General Manager under the receivers. When Mr. Corbin became President Mr. McLeod was made Vice-President and he became President in June, 1890.

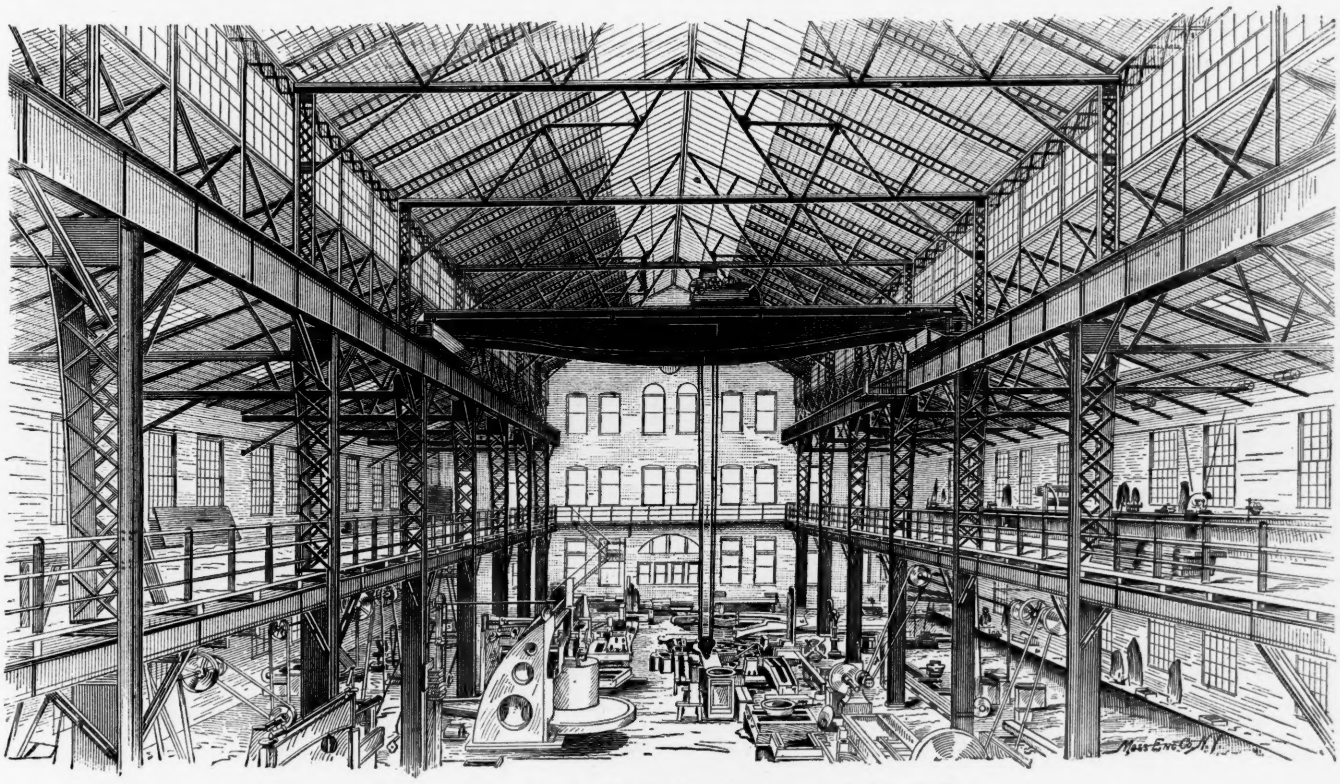
In February, 1892, the great anthracite coal combination was formed by leases which linked in close union the Reading, Lehigh Valley and Central of New Jersey. As soon as this combination was perfected and Mr. McLeod found himself, as he believed, master of the situation, he began to disregard the advice of conservative men. The price of coal was arbitrarily advanced with such rapidity that public outcry was at once raised and the civil authorities began steps to contest the legality of the leases. Then came suits by the New Jersey authorities and finally the complete failure of Mr. McLeod's scheme to control the anthracite coal market. The Jersey Central lease was declared illegal and its cancellation followed. Reading found itself overstocked with coal and without funds. Last week even the pay cars were recalled by telegraph in order that funds set apart for wages might be used to stave off the inevitable collapse.

President McLeod's first mistake was the attempt to gain an entrance into New England by the way of the Poughkeepsie Bridge. The Reading company owns all the stock and guarantees the principal and interest of the bonds of the Philadelphia, Reading & New England. There is good reason to doubt the assertion of Mr. McLeod that he also secured the control of New York & New England. At any rate, President Charles Parsons has refused to resign.

Machine Shop Roof at Buffalo.

Modern machine shop construction has taken rapid strides in the past few years. The low price of iron and the largely increased use of traveling cranes necessitate an entirely different construction from the old fashioned machine shop and jib cranes for moving materials. The illustration shown above is taken from a photograph and shows the interior of the new machine shop of the Lake Erie Engineering Co., at Buffalo, N. Y. The building was built by the Berlin Iron Bridge Co., of East Berlin, Conn., and is 50 ft. in width from centre to centre of crane girders, with a wing on each side 28 ft. in width of two stories high. A power crane controls the entire floor service of the central portion of the building, which is made high so as to admit of being used as an erecting shop. The wings are controlled by jib cranes and are designed for lighter work in the second floor. The building is absolutely fire-proof, as the walls are of brick, the roof of iron, slate and glass. The only woodwork in the construction of the building are the floors.

Particular attention is called to the lighting of the interior of this shop, as so many machine shops are lacking in this essential feature. Along the central ridge of the entire length of the building is a skylight 12 ft. wide on each side of the centre, which gives a well diffused light through the centre of the building, and also on the second floor of the galleries. Light is also admitted by side windows placed far enough above the crane girders so that the latter do not interfere with the free distribution of light. Skylights are also provided in the roof of the wings on each side, being placed in alternate panels. These, taken in connection with the windows in the side walls, furnish ample and well diffused light through every portion of the building.



Machine Shop Roof, Lake Erie Engineering Company, Buffalo, N. Y.

Made by the BERLIN BRIDGE COMPANY, *East Berlin, Conn.*

New York Railroad Club.

The following topics were set down for discussion at the monthly meeting held at 7:30 p. m., Thursday, Feb. 16, at the rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York:

1. Should dead blocks be applied to freight cars with M. C. B. couplers?

2. Can a successful draft rigging be applied to freight cars without the use of auxiliary timbers, fastening draft gear direct to end and centre sills?

3. Which offers the most security for automatic couplers, a tail bolt or a yoke attachment?

4. Is any device using a netting a real "spark arrester"? If there were absolutely no laws on the subject except that roads should pay for damage done by fires caused from locomotives, would any of us use extension fronts or diamond stacks?

5. What are the best proportions for driving boxes? Is not the present size faulty design, and can it not be remedied easily?

6. Under the present system of double-crewing, chain-ganging, or pooling engine crews, how much work should they be expected to do on engines? With the heavy traffic, many signals, road rules, etc., now used, would it not mean better service to hold the crews responsible for the train in motion and let inspectors do the work on the engines?

Owing to the large number of topical discussions handed in, it was deemed advisable not to have a regular paper this month.

The secretary reported that the membership of the club was now 249, being an increase of 21 members since the last meeting. The names of several candidates for admission to the club were then read, and as they had been approved by the executive committee, they were all unanimously elected.

The first question on the list was then discussed.

Mr. C. A. SMITH asked why are some railroads removing dead-blocks from cars with vertical plane couplers? The Western Railroad Club do not understand why this is being done. The Western people have always been opposed to dead-blocks, but now there seems some difference of opinion, and a statement of the reasons *pro* and *con* would be useful.

Mr. WEST (Madison, Alton & Chicago) was putting them on all cars, and found that connecting roads would not accept cars without dead-blocks. Experience showed that dead-blocks protected the Butler draft rigging.

Mr. BLACKALL found that they protected the draw-head and life, though not the limbs of the brakemen.

Mr. LEWIS believed that dead-blocks were a necessary evil for the same reasons, though they smashed hands and arms. Considered dead-blocks saved knuckles of vertical plane couplers.

Mr. WATSON thought dead-blocks injured many more men than if none were used, though they protected the coupler.

Mr. WEST thought it depended on the position of the dead-blocks, and made all his dead-blocks come together before the springs were fully compressed.

Mr. WATTSON thought that dead-blocks long enough to protect couplers would prevent coupling on curves. The M. C. B. dead-block was no protection to the coupler, but if M. C. B. coupler is properly supported from behind, no dead-blocks are necessary. He had seen sills broken off in rear of Graham draft rigging, showing that no dead-blocks would do any good in the very severe service to which cars are now exposed. Dead-blocks 8 in. thick were no protection for couplers that stood out 11 or 12 in.

Mr. BLACKALL instanced a collision where the only drawbars not injured were protected by dead-blocks.

Mr. MCDONALD (Supt. Central of New Jersey) declined to discuss technical subjects where some one could talk back. All Superintendents and General Managers like to lay down the law on technical subjects when no reply could be made.

Mr. C. A. SMITH could not see the use of dead-blocks with M. C. B. coupler as regards the protection of trainmen. If men are careful, dead-blocks are a safeguard, but are none when men are careless.

A MEMBER said that when a brakeman going between Western cars, he had always to consider the probability of the drawbars going out of sight in coupling and in a slight collision they go to pieces, while Eastern cars stand. Dead-blocks should be universal.

Mr. MENDENHALL (Pennsylvania): If no dead-blocks were used the strain must be taken up by the coupler which was placed beneath the line of sills, which consequently broke off near the body bolster.

The discussion on this subject then closed.

Question 2.

Mr. ENNIS asked how Mr. Rhodes fixed his drawgear in line with the sills.

Mr. C. A. SMITH had, some years ago, arranged a drawbar without draw fixtures or draft timbers. It drew from the bolster and buffed against the end sill, but as the drawbar would be totally different to any now in use, there would be a difficulty in repairing at a distance from home, and this caused him to drop the invention. It differed from Hoyt's drawbar, which has draft timber fixtures. The principal strain on couplers and draft timbers was the concussion in buffing. The body of the car would be lowered to suit his method.

Mr. ROGERS said that Mr. Rhodes' method involved some alterations in the height of platforms and freight houses, as the whole body of the car was lowered.

A MEMBER stated he had lowered the drawgear and **cut a 4½ in. aperture in the end sill of a derrick car**

where it was necessary to lower the platform of the car as much as possible. The hole in the end sill had been strengthened by an iron plate and the arrangement had worked well for several years.

Mr. MENDENHALL (Pennsylvania): Some refrigerator cars are running without draft timbers, depending wholly upon bolts which work loose.

Question 3.

Mr. BENSON considered a bolt safest and best for any coupler.

Mr. C. A. SMITH had 2,000 cars running with a tailbolt 2¼ in. diameter, with two keys, one front and one back, 2½ in. × ½ in. These were the largest size cars carrying 8,000 gallons, and none of the bolts or keys had broken. Keys were made of the best quality of malleable iron; one key was used in place of the head of the bolt. The piecework price for removing a drawbar with this bolt was 20 cents; for one with a yoke 40 cents. If a 2¼ in. bolt was made of good iron it was perfectly safe. The usual size was only 1¾ in. to 2 in. diameter. Some roads use a head on the bolt, but it usually draws through the drawbar, often after a few months' running.

Mr. MENDENHALL: The tendency out West is to use a strap, possibly because they haul heavier trains. Ordinarily half inch keys will break and bend.

Mr. LEWIS: The opinion in the West is against the tailboat.

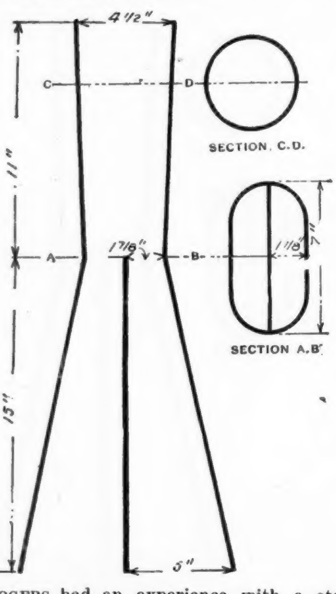
Mr. HILL (*Locomotive Engineering*): 2-in. bolt with a head has only ¼-in. shoulder and will work through the drawbar, and if the heads are hexagonal, the bolt will work round, rub the ring in the key through from friction against the draft rigging, and allow the key (being reversed) to drop out. The M. C. B. standard 2-in. tailbolt often broke, but he had never seen a broken yoke, the latter was stronger and more durable.

Mr. GEORGE L. FOWLER had examined a number of broken tailbolts; most were broken just under the head where the iron was much crystallized, showing that the bolt was not hot enough when headed. Others were broken and crystallized in the key-way by drifting the hole out. Bad workmanship often caused broken tailbolts.

Question 4.

Mr. R. M. DIXON said that netting was only a partial cure for sparks.

Mr. SANFORD (Pennsylvania): Forty years ago engines had no spark arresters. A vertical cylinder punched full of holes went down within 6 in. of the bottom of the arch. The extended front does arrest sparks as shown by the quantity it collects.



Mr. ROGERS had an experience with a stationary engine, in which he prevented sparks by combining an extension front, a diamond stack, and a brick arch with some extra netting.

Mr. LEWIS considered that such an elaborate arrangement would effectually prevent sparking in any village however small.

Mr. HILL considered that small blast nozzles were often the cause of sparks, and had found engines steam well with larger nozzles. No engines could do heavy work without occasionally emitting sparks.

Mr. BENSON (Ulster and Delaware) considered the extension front a good spark arrester, but not perfect.

Mr. ANGUS SINCLAIR had never seen locomotives which made no sparks, but the best forms of a spark arrester minimize them. Most spark arresters obstruct the draft, and engines with no obstruction can run with much larger nozzles. The earlier use of wood fuel in this country necessitated small nozzles and elaborate arrangements for arresting sparks, and these were continued when coal was introduced. If there were no lows on this subject, less fuel would be burned, and no spark arresters would be necessary.

Mr. BENSON (Ulster & Delaware) was using a new form of blast pipe on both hard and soft coal burning engines. The form of this blast pipe for anthracite burning engines with 18-in. cylinders was shown in the accompanying sketch. The top was 16 sq. in. area, the area of each opening at the bridge 11⅝ sq. in., and the area at the base 19⅝ sq. in. It was virtually a single nozzle and gave about 50 per cent. larger opening than each of the old single nozzles. He used to use two 3¼-in. nozzles of 8¼ sq. in. area for 18 × 24 cylinders. The top of the improved blast pipe was 21 in. below the base of stack for 15 in. stacks and 23 in. for 16 in. stack, so that the exhaust would fill the stack. A diaphragm placed between the flues and the nozzle was manifestly an obstruction to the draft and a crude contrivance, but appeared the best known. Had any one tried to run engines without anything in the smoke arch?

Mr. MONTGOMERY (Central of New Jersey) considered an extension front, in combination with a brick arch, was superior to the diamond stack for many reasons; first, because the netting surface was larger. In the diamond stack the netting would stop up, but the larger opening in the extension front cured this. Second, the netting was not so apt to choke up with sparks, because the sparks were drawn and not driven into the netting. However, with the extension front, the nozzles tend to stop up more than with the old style, but if the nozzles were kept clean no more coal would be burned. The cost of repairs is less. He had some nettings that ran for years. The joints must be kept tight. Mr. Forney had stated that 196 lbs. were burnt per square foot of grate on a Baltimore & Ohio engine. If this was a fair criterion of usual practice, sparks must be thrown and some means of arresting them must be used. He could not understand why no sparks were thrown in England, especially as he understood they used no netting there.

Mr. D. H. NEALE (*Railroad Gazette*) said that it was some years since he had been in England, but when there some form of netting was generally considered essential to prevent sparks, especially in dry weather in the fall, when fields were often burned for miles. The nozzles used were, however, much larger and as the amount of water evaporated a pound of coal was considerably greater, far less coal was used than here, and consequently the tendency to sparking was not so great.

Mr. ANGUS SINCLAIR thought the difference between extension front ends and the diamond stack was simply in the direction in which the sparks were thrown. The former threw them straight up and the latter distributed them around the train where they were felt.

Mr. MONTGOMERY could not accept this and pointed out that the sparks were retained in the extension front.

Discussion on this subject then closed.

Question 5.

Mr. GEO. L. FOWLER stated that commercial malleable iron was not made malleable for more than ⅜ in. from the surface and this was exceeded only in special instances.

Mr. WEST thought that old boxes were too light; he was successfully using sectional instead of crown bearings, filled with white-metal.

Mr. PURVIS (Boston & Albany) had used steel boxes for years with sectional bearings. The side next the hub of the wheel was faced with babbitt sometimes ¾ in. thick. The hub wear was very slight and none of the boxes had broken for many years. The babbitt was put in by drilling 20 half-inch holes, half inch deep in the box, one-half outside and one-half inside. After the holes were driven, one lip of the drill was shortened and the holes counter-bored at the bottom; the babbitt was then run in.

Another member used steel boxes and pinned brass liners to the hubs. This arrangement answered well, but he had no trouble with cast iron boxes when made of charcoal iron.

Mr. SANFORD said that on the Pennsylvania steel boxes on the class "P" engines ran hot, and they finally used solid phosphor-bronze boxes, but found the lugs broke off, the springs being underneath the box. A 10-in. box was probably long enough.

Mr. DIXON considered that increased area should be given in the box by lengthening it rather than by increasing the diameter of the journal.

Mr. MONTGOMERY used gib brasses of magnolia metal with success. If the boxes were lengthened, the centre of the journal would be out of line with the centre of the frames, and asked if this would give trouble.

Mr. D. H. NEALE replied that though this arrangement was very unusual in America it was very universal in Europe. He had designed many engines with journals 11 × 8, the centres of the boxes being 4¾ in. from the centre of frames, but if the frames were well braced together so as not to twist there was no trouble.

Mr. FULLER had seen a few engines with boxes out of centre; they ran all right. All builders are now increasing the size of boxes.

The consideration of *Question* 6 was then postponed to the next meeting and the club then adjourned.

The Controverted Questions in Road Construction.*

BY JAMES OWEN, M. AM. SOC. C. E.

In view of general agitation throughout the country for the improvement and betterment of existing highways and of the seeming differences of practice by engineers in the construction of improved roads, it occurred to the writer that a continuous experience of 26 years in such construction would afford a basis for an intelligent discussion tending to a crystallization of practice that would be of benefit to the profession and save money to the community. . . .

The main question of artificial road construction may be divided into three heads:

1. Where there is an amplitude of stone of any and every kind without special adaptation.
2. Where the stone found by experience to be the best for the purpose exists.
3. Where no stone exists.

The locality and quality of stone found especially fitted for road work are of such economic importance and so interwoven with other issues that it seems more desirable to allude to them, as their importance will appear in discussing other questions of construction. There is one feature connected with the general supply of stone which should be noted—that in mountainous countries there is poor farming land and plenty of stone, and in alluvial countries there is rich land and no stone; the general law of compensation coming in as usual.

The question of highways in detail is now before us and the points can be classified as follows:

1. Line and grades. 2. Drainage. 3. Material. 4. Thickness. 5. Size of stone. 6. Manner of construction. 7. Repairs.

The general principles of lines and grades are practically so well established as to require no discussion. The shortest line consistent with the easiest grade sums that point up in a few words. As to minimum and maximum grades, location and money govern these points largely, assuming, as does the writer, that in establishing an ideal grade of 1 per cent. any departure therefrom is to a certain extent to be resisted. A grade of 1 per cent. gives ample fall for water, and consequently proper drainage, and practically entails a very small percentage of extra duty on a horse.

The minimum grade should never be less than 6 in. in 100 ft., less than that debarring proper flow of water; the maximum grade for ordinary country and general travel should be 4 per cent., which is the limit of an ordinary trotting gait. On steeper grades a horse practically comes to a walk; grades up to 10 per cent. in mountainous country are permissible, steeper grades than that are not economical, and are bad engineering.

It should be understood that in all cases the centre of the road should have a grade, thereby avoiding any possibility of a roadbed that is in fairly good condition harboring standing water; and, if possible, all gutters should have a sufficient fall besides. The ideal picture extant in road treatises, showing cross-sections of Telford and Macadam roads with large ditches on each side half full of water, is something every professional tyro should avoid, and is only permissible, on very rare occasions, in very flat country; and as very little of the earth is flat, the insertion of such a drawing as a standard type of road construction should be eliminated from the next textbook issued on the subject. . . .

In a 16-ft. roadway an average crown of 4 ins. is desirable; to get this an extra allowance of 1½ to 2 ins. should be made in construction, and probably 1 in. in repairs. If the grade of the road is steeper than 5 per cent., this crowning should be increased at least 1 in. to prevent the water from running in the centre of the road and washing the material away. . . .

The most palpable effects of bad construction are at that most interesting period of the road engineer's yearly life when frost is coming out. At this period any defects of drainage, as well as many defects of other kinds, are made more glaring, and the effect of frost's silent but insidious efforts practically concentrate the engineers' combative energies, and, in vanquishing this trouble all other difficulties appear trivial. The writer's opinion is that, in the contest between Macadam and Telford, as to the relative superiority of their respective methods of road construction, a steady winter's frost penetrating the ground to a depth of 4 ft., and then coming out with a rush, would have settled the quesion for all time, and left Mr. Macadam practically nowhere. In England, where the controversy took place, frosts are practically unknown, and road experience in such a climate is worthless here. . . .

The qualifications of the different rocks for road construction depend, first, on their proposed use—whether for the top wearing surface or for foundation; and, secondly, on their natural fitness for the duty imposed on them. . . . Any good hard rock capable of resisting frost and of irregular shape (*i.e.*, not round) may be used in foundations; hard stone is better than sedimentary rock, but a case of any good material being crushed or broken in a foundation, by any load being placed upon it, has yet to be observed. To the writer's mind this is an important point gained, as, in the interest of economy, the use of any available stone will be of paramount importance. For the wearing surface, whether it has a foundation under it or not, the selection of available material is much more limited, more open to controversy and affords a growing field for the speculator and enterprising business man owning a quarry, to work his stone on the market, be it good, bad or indifferent. As all material used for wearing surface is crushed or broken, it has received the generic name of broken stone, and it will be so entitled here. . . .

Taking a broad view of this question, the writer would say that it would be more economical to haul trap rock 300 miles by rail than to use granite or limestone found at site; to haul granite 200 miles rather than to use limestone; and that limestone is only economical or desirable in the locality in which it occurs. Water carriage, of course, would disturb this ratio somewhat, but this statement gives his idea of their relative value; note should be made that the largest item of cost in transportation is the small haul by wagon.

The variations of the texture of the trap rock itself are also pertinent in an economic view. With a plethora of such material the writer has selected the close-grained basaltic trap to the exclusion of the coarse-grained ledge trap, having found that the wearing qualities of the former exceed those of the latter in the proportion of about 100 to 80. Syenitic rocks, in his experience, have not been much used, and information on that point would be of use. The availability of granite depends upon the amount of mica it contains; the more mica there is in it the less are its wearing qualities, and gneiss should be debarred entirely. The success of the hard limestone in many localities is due, in the writer's opinion, to its comparison, not with harder and better rocks, but with the aboriginal mud; a well constructed road of limestone being so superior to a mud road as almost to prevent comparison; but when compared with roads of hard igneous rock, limestone roads are deficient in durability, or dusty in dry weather and muddy in wet. . . .

We now come to the question of the thickness of roads, and incidental to that is the form of construction; for it is to be presumed that a thick pavement would, in the interests of economy, be constructed with a foundation and a thin pavement of broken stone alone. The statement might as well be made here that the writer is unqualifiedly in favor of thick pavements with a foundation, and opposed to thin pavements of broken stone. His early experience having been entirely with Telford pavement he might be accused of prejudice, but since the controversy on the question that occurred about three years ago he has built miles of thin pavements, and the result of his experience in such work is that he will sin no more. . . .

It is proper to concede at once that in districts where the soil is gravely or sandy, thin macadam roads may be used with success and economy; the city of Bridgeport, Conn., is a striking example of this. Better roads or streets in any community would be hard to find. The area of gravel or sandy formation in the whole country is, however, necessarily limited, and a practice that is a success with such a soil would be at least open to criticism in the bottomless mud of the Ohio Valley.

All that section of the United States south of an isothermal line (if one could be constructed) with the limit of frost entering the ground to a depth of 8 in. might be considered a fair field for thin pavements, subject, of course, in such localities to the possibility and necessity of good drainage, as well as a systematic comparison of the cost of said drainage as against the increased cost of the insertion of the pavement. In all mountainous countries necessitating grades of over four per cent., thin pavements can be judiciously used, but as in such districts the prevalence of stone immediately at hand would probably offset such a requirement it would be more economical to build a thick road with a foundation of local stone than to haul broken stone from a distance.

Eliminating these three localities from the question, we have the vast area left of the best farming country on the continent, more particularly requiring good roads for the transportation of their produce; and in constructing such roads, to the writer's mind, a foundation is a necessity. In the writer's early experience he built roads 16 in. thick, then reduced them to 12, and is now for ordinary country roads building them 8 in., with good economical results; the surface is uniformly good, ruts are rare, and the question of breaking up by frost never arises, as such a thing never occurs. All these roads were built with foundations of reasonably square stone, firmly and carefully wedged, special importance being attached to complete and proper wedging.

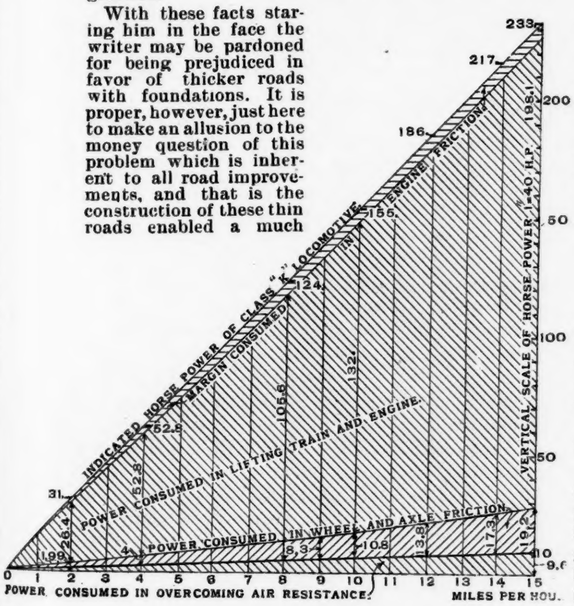
It should be understood that the idea of a pavement should be maintained in these roads built with foundations, the stone should be laid as close as possible by

* Extracts from a paper read before the American Society of Civil Engineers, Dec. 16, 1892.

hand, and chips driven in and wedged on top, thus practically, with the crown of the road, making an arch, and immediately distributing an excessive load occurring on one stone to its neighbor, and completely obviating any settlement. Incidentally, also, the foundation stones act as a drain for the water, and such an effect does this have on the permanent condition of roads that the writer has now adopted the practice of making the thickness of roads dependent on grades and adopted this rule: Grade less than 1 per cent., 10 ins.; between 1 per cent. and 5 per cent., 8 in.; both with foundations: over 5 per cent., 6 in. of broken stone. . . .

As has been stated, the writer made an attempt at the construction of 4-in. roads, and after two years' trial gave it up; in one case had to give it up, as his work was not considered satisfactory, and another and more enthusiastic engineer is making the same attempt. The result found in the construction of these 4-in. roads was entirely in accord with his previous practice; those on steep grades stood very satisfactorily, but in flat grades they rutted badly in the critical period of frost, parts of the 4-in. pavement disappeared, and the result was a permanent defect in the road or an immediate necessity for repairs, both of which are, in a professional view of the matter, quite improper. In an adjoining county the exclusive practice has been to build 4-in. roads, the idea starting, probably, from the fact that a large city of the county, situated on a gravelly bed, had used 4-in. roads for a number of years with success. This practice, having been extended throughout the entire county, gave very satisfactory results for about three years, and enabled a large extent of country to be supplied with good roads at a very moderate cost, and the taxpayers and officials were correspondingly elated. A severe winter spell, such as had not appeared during this period of three years, and lasting for about a month, dealt a rude blow to their satisfaction, and played havoc at the same time with the roads. Being interested in the matter, the writer inspected the condition of these roads and counted 42 places in a distance of 1½ miles where the pavement had blown up and the virgin red soil was protruding on top, and in one section of road, built only the fall previous, a length of at least a quarter of a mile had been abandoned by travel which had reverted to the original mud as the easier method of progression.

With these facts staring him in the face the writer may be pardoned for being prejudiced in favor of thicker roads with foundations. It is proper, however, just here to make an allusion to the money question of this problem which is inherent to all road improvements, and that is the construction of these thin roads enabled a much



Horse Power, Manhattan Locomotive.

larger extent of territory and population to be accommodated with an immediate improvement of roads than would have been done with a more costly construction. The repair of the failures noted above was soon accomplished, a good road is still there, and probably will be maintained. In the end, of course, there will have been a much larger expenditure of money; the community, however, will then be educated to the fact that repairs are a necessity and must be provided for, and as a result they will be provided for, the question of comparative cost not entering into the question.

It is agreed on all sides that the roadbed should be graded to a surface uniform with the finished roadway. On this, in my practice, is laid the foundation, without rolling, as I prefer to adjust the bed to the varying depth of stone, by digging it out if necessary, for the stones, rather than to break off the stone on top to fit the pavement; in thin pavements it is universal to roll the roadbed before the broken stone is put on, and with this practice I am in accord; but it is also almost universal to roll the bed for a Telford pavement, to which practice, after trying and abandoning it, I demur. . . .

After the foundation is laid and wedged, according to the accepted practice alluded to before, a coating of loam or clay is placed therein to the thickness of about ½ in. to ¾ in. This is merely put there to prevent the spawls working up and mixing with the smaller broken stone above, which they will surely do unless great care is taken in rolling, which costs money, and it is more economical to use the packing. . . .

After placing our packing on the foundation, let it be rolled to a uniform surface, on which place and spread broken stone of the required size and thickness; let this be continually and repeatedly rolled till it is as thoroughly consolidated as it can be by a roller; on this place another thin coating of packing, which should be rolled also. It is better at this time to roll the broken stone and packing at the same time, working the roller backward and forward over each, and, if possible, inviting the travel on the surface at once; this travel, of necessity, causes ruts, but the roller soon works them out, and the more ruts that are caused by travel before the roller leaves the work, the more thoroughly homogeneous will the wearing surface be. After this, let the travel have full scope on the road, and after the contingency of surface ruts is eliminated spread the screenings and roll them down thoroughly.

Another point of controversy is the question of rolling. The rolling of a road is unquestionably conceded as a necessity of construction and repairs, and the writer would be loth to gainsay it; but notwithstanding his acquiescence thereto, he is satisfied that no amount of rolling *per se* will ever succeed in making that great desideratum of road construction, a homogeneous mass of broken stone, as well as the wheel travel itself will do. To that end he uses the roller as an adjunct to invite the wheel travel to do its work, and not to finish the road ready and complete for the travel itself; this, of course, applies more particularly to repair of roads; but as the construction of a road is incidental, and the repair is perennial, the practice in repairs is more important than the mere item of construction.

The writer must again revert to his early experience and state that, in common with the practice of twenty years ago, he then inserted a clause in his specifications requiring a steam roller; subsequently he eliminated this clause, and has yet seen no cause to revert to it . . .

Considering a bulk of broken stone as a mass of wedges, it is a well-known principle that no static vertical pressure can compress any hard material of such character to an appreciable extent, and to accomplish settlement of broken stone motion is necessary; the more continuous and repeated the motion the more decided the settlement. It is therefore apparent that the application of two tons 100 times on a mass of broken stone will be much more efficacious than the application of 20 tons 10 times—and the experience of the writer tends to confirm this theory (if theory it be)—and so for the last 15 years a steam roller has not been required or used by him. . . .

The only remaining item of construction that can be alluded to is the use of screenings, and its consideration applies also to repairs. To the writer's mind a coat of screenings is like a coat of paint which may be used to cover up putty holes in wood or blowholes in iron, and while in the construction of roads he has not departed from the practice of using it, in repairs he finds that satisfactory and economical results can be obtained without it. . . . On a heavy traveled road the writer has noticed that a good coating of screenings, say, ½ in. thick, will last from three weeks to a month, and then the travel gets to its proper bearing, viz., the 1½ in. stone; a coating of screenings costs from $250 to $300 a mile, and to his mind it is an expensive luxury. . . .

In repairing roads the practice of the writer is to put the broken stone on, and roll and treat it practically in the same manner as the top course of the original construction; the stone of the 1½-in. size being put on about 3 in. thick, with the necessary rolling and packing. Dust or screenings may or may not be used, as the pockets and desires of the community dictate; a coating of dust, of course, gives quicker and consequently more satisfactory results. . . . The practice of isolated patching and repairs is to be condemned except under urgent necessity; if a road is rutted the ruts undoubtedly should be filled up, not with screenings, as is often done, but with the 1½-in. stone; if the road breaks up, of course it should be repaired, but, as has been said, no well constructed road either breaks up or ruts.

Horse Power of a Manhattan Locomotive at Various Speeds.

The annexed diagram shows the increase of horse power required at different speeds with a standard Manhattan Elevated locomotive drawing a regular five-car train loaded with passengers up a two per cent. grade, as determined by the Manhattan Railroad Co. from their records.

The following are the data on which the diagram is based:

Class "K" engines, cylinders 12 in. × 16 in.; drivers 42 in.; total weight, 24 tons; mean effective cylinder pressure, 100 lbs. per sq. in.; gross tractive power about 5.500 lbs.; train weight, five loaded coaches = 100 tons; grade, 105.6 ft. per mile; atmospheric resistance, with head wind of 10 miles per hour at speed of 15 miles per hour = 3 lbs. per sq. ft. on 80 sq. ft. Wheel and axle friction figured by Burlington brake test formula $3.5 + \frac{V^2}{367}$.

Foreign Railroad Notes.

The effect of the reduced passenger and express rates on the French railroads is indicated by the receipts of the six great companies for the seven months from April 1, when the reduction went into effect, to Oct. 31, compared with those of the previous years. They were, in francs:

	1892.	1891.	Decrease.	Per cent.
Passengers.......	267,005,851	283,519,626	16,513,775	5.8
Express..........	59,350,300	64,934,871	5,584,571	8.6

The total decrease amounts to the considerable sum of $4,400,000. The times were bad, and there would probably have been some decrease in earnings if rates had not been reduced, but doubtless it would not have been so great, especially on express traffic.

We noted at the time the orders to increase the capacity of freight cars on the Prussian State Railroads from 10 to 12½ kilometric tons (22,000 to 27,500 lbs.) A statement of the progress of this work down to the 1st of October last shows that it had been completed on 46,072 cars out of the 50,628 which were to be changed. Besides this a large number of 15-ton cars have been built, and a considerable number of eight-wheeled cars to carry 30 tons (66,000 lbs.). The official report of changes show that besides the old 10-ton cars, there were 1,082 eight-wheeled 20-ton flat cars on the State system, which have been made to carry 25 tons. Most of these belong to Rhenish lines.

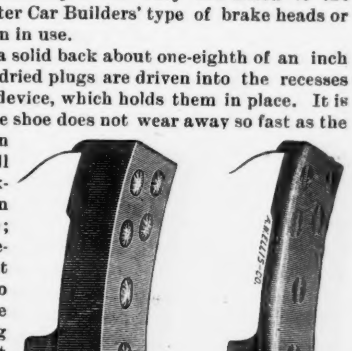
The Gotthard Railroad (165 miles long), which has cost at the rate of $296,757 per mile, has not a very heavy traffic. In 1891 the train movement over the road was equivalent to 11½ trains each way, and the traffic movement to 331 passengers and 949 tons of freight each way daily. The passenger and freight train mileage are not reported separately, but the average number of *axles* per train was 30, indicating very small trains, which the nature of the road requires. The average *gross* weight of trains is given as 198 tons. The average rates were 2.27 cents per passenger mile and 2.038 cents per ton per mile. The earnings per train-mile were $1.86; the expenses, $1.07; the gross earnings per mile of road, $15,141; the net, $6.392. This being a road built expressly for international traffic crossing the Alps, it is surprising to see how large a part of its traffic is local. The average passenger journey on it was only 29 miles in 1891, or less than one-fifth of the length of the road, and even the average freight haul was only 91 miles. The road is worked with a force of 2,299 men, or an average of 13.9 per mile. No less than 814 of these, or nearly five per mile, are employed in guarding and maintaining the road.

A passenger starting from Paris for Rio Janeiro bought a through ticket for Porto, in Portugal, at the station of the Orleans Railroad, which read over the Northern Railroad of Spain, and delivered his baggage. On account of the falling in of a tunnel on the Spanish railroad, the passenger was compelled to take another line at a cost of 152.75 francs. But the Spanish custom house authorities had sealed his baggage, and would not let it be forwarded for nine days, in consequence of which the passenger had to wait for the next steamer for Rio. Hereupon he sued the Orleans Company for the cost of the ticket, 152¾ francs, and for 2,750 francs expenses while waiting for the next steamer. The company claimed that it was not responsible for what happened on the Spanish railroad or what was done by the Spanish custom house. But the Paris Commercial Court decided that the passenger's contract was with the Orleans company, and that he had a right to hold it responsible for its non-fulfillment, and that the refusal of the Spanish custom house to permit the baggage to be diverted from the route by which it was billed would not have had any effect if the contract had been kept, the failure of the tunnel not being what we would call "an act of God," but something for which the railroad should be held responsible. It therefore awarded the complainant the amount paid for the ticket, but apparently found his hotel bill extravagant, and allowed him but 1,000 francs for his delay in Porto.

A Composite Brake Shoe.

We show engravings of a new composite brake shoe brought out by the Safety Brake Shoe Company, 620 Atlantic avenue, Boston, W. W. Whitcomb, President. During the past year this company has been introducing in electric street railroad service a cast iron brake shoe, having in the face holes into which are inserted wooden plugs, by which, with less pressure of the brake on the wheel a better gripping effect is said to be obtained. This seems to be apparent not only to the motorman, but in its effect on the car and truck, especially on the journals, bearings and boxes, preventing in a great measure the jerking and jumping of the car. Mr. Whitcomb has recently patented some new devices in this type of shoe for use on steam railroads, in place of the ordinary shoe. They are fitted to the Christy or Master Car Builders' type of brake heads or any other design in use.

The shoe has a solid back about one-eighth of an inch thick, and kiln dried plugs are driven into the recesses with a locking device, which holds them in place. It is claimed that the shoe does not wear away so fast as the ordinary iron shoe, and will give better braking service than any shoe in use; that the engineman need not set his brakes so hard to get the required braking effect, and that there will be less squeaking of the shoes on the wheels, an important consideration on elevated railroads. It is also claimed that these shoes have never been known to be heated in service.



New. *Partially worn.*

These shoes are in service on several steam railroads in New England and other parts of the country, on one road especially with a view to testing their non-heating features. It is the opinion of well-known master mechanics that as one-third of the surface is wood, and the holes round and not presenting a cutting surface, a chilled shoe made this way can be used without slipping or cutting, even on steel or steel-tired wheels, and largely increased mileage be obtained. Such shoes are now being made and will be thoroughly tested.

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

The Philadelphia & Reading.

The startling rise of the Reading to the position of a putative controller of the anthracite trade and a daring and dangerous leader in great schemes of railroad consolidation has been equaled by its swift descent to the position of a ward of the court, shorn of most of its power for good or harm. Only a year ago the leases of the Lehigh Valley and the Central of New Jersey were made. This bold enterprise was immediately preceded by control of the Poughkeepsie Bridge route and was quickly followed by an exchange of directors between the Central of New Jersey and the Lackawanna, with an "understanding" as to rates and output; and then by purchase of a large interest in the Boston & Maine, and the control of the Connecticut River, and an effort to control the New York & New England. This was a good deal to do in one year by any one, and particularly by a company which had not earned dividends for many years and was overloaded with bonded debt. It turns out to have been too much. In one week in February, 1892, the volume of transactions in Reading shares in New York and in Philadelphia amounted to more than six times the whole share capital of the company, and quotations rose from about 43 to 63½. In the past week the total stock has been sold more than once certainly; on Monday alone the shares sold were about 20 per cent. more than the total number, and the price fell in a week from 47 to 28. Where the control of the property now remains is entirely a matter of conjecture. It is claimed oftenest for the Vanderbilts and Mr. Pierpont Morgan, but there are those who suspect that it will be found in the hands of the Pennsylvania, while Mr. McLeod is reported to say that it still rests with him and his friends. Probably there are not half a dozen men in the world who know—if so many. Until this uncertainty is cleared away, speculation as to the future would be idle.

This end of the Reading's excursion into the field of great combinations was not unexpected, but few could have looked for it so soon. The *Railroad Gazette* has from the first doubted the permanence of the arrangement. Last February we said "this leaves about 30 per cent. of the coal not controlled by these two companies [Reading and Lackawanna]. Any one who has followed the history of competition knows that a proportion half as great as this often defeats entirely the plans supported by a combination of all the rest. . . . The Pennsylvania alone has one-eighth of the shipments, and it reaches all the markets. . . . The risks of the new arrangement fall on the lessee, which is financially the weakest of the great coal producers. . . . The outside companies will resist any attempt to reduce their percentage of the output; and the Reading certainly will not be able to reduce them to subjection by doing business without a profit for a year or so, for it, less than almost any other coal railroad, is able to endure a reduction of profits, and this new contract makes it necessary to increase them." In fact it was necessary under the terms of the lease to increase the dividend paid to the Jersey Central and the Lehigh Valley more than $300,000 in 1892 and about $1,100,000 a year thereafter. To do this one of two things must be done, if not both; coal rates must be advanced or shipments increased. We all know that rates have been advanced. A very cold winter has helped the combination to keep up prices, and the *outside companies* have made hay with great energy; but the Reading combination appears to have lost. The total shipments of anthracite for 1892 increased 1,444,983 tons, but the shipments by the Reading roads *fell off* 1,122,483 tons, while those of the outside companies increased 2,567,466. This latter group includes, however, Coxe Brothers & Co., whose increase was alone nearly one-half of the total; and in this the Reading is supposed to have profited substantially. But it is quite evident that when the results of the year's operations are cleared up the Reading roads will be found to have made considerable money for the other coal producers and carriers, and lost, or at any rate made little, for themselves. And the first great and necessary object of the combination has failed.

If this alone were not enough to account for the collapse of the great fabric, we need not go far to seek other causes. The legal dissolution of the lease of the Central of New Jersey made the continuance of the co-operation of that company uncertain, and the invasion of New England was a mistake from the start. The purchase of the Poughkeepsie Bridge and its connecting roads was a heavy charge upon the Reading for a very speculative advantage. The theory of a profitable all-rail coal business by the way of the bridge we have always thought fallacious, for reasons that we have often stated; and there was nothing in the new conditions to make a group of properties which have never been able to earn fixed charges anything but a burden. The more recent attempts to control the Boston & Maine and the Connecticut Valley were made at a great cost. The prices paid for the stock were very high even for such good properties. Then came the attempt to get control of the New York & New England, which it is said was made by individuals and not by the Reading corporation, but which crippled the individuals who otherwise could have and would have helped that corporation in its straits. Finally there was the pledge of $5,000,000 of bonds to borrow $3,000,000 to pay interest on preference bonds. These steps, with the accumulation of a floating debt estimated all the way from $6,000,000 to $20,000,000, precipitated the event which has been foreseen by a good many men.

Blast Nozzles.

The meeting of the New York Railroad Club held on the 16th was very successful and well attended, and five different questions were discussed. Reference was made to the possibility of running locomotives with a large blast nozzle and without any spark arresters, and the Secretary of the Club stated that during his visit to England last summer he found that this was almost the universal practice in England, and that only one line used spark arresters. This, of course, seems to us a very remarkable state of affairs, especially when engines for doing the same service have a far smaller heating surface there than is customary here for the same sized cylinders, adhesion weight and boiler pressure. Many members asked the cause of this difference, and while it is difficult under the different conditions to say whether engines there are as hard worked as here, there are many reasons why less sparks should be thrown by English locomotives than by American.

If two engines having similar proportions and using the same amount of steam per mile are compared, and one engine evaporates only 6 lbs. of water per pound of coal, it is obvious that its consumption of coal per hour for the same amount of steam generated will be 50 per cent. higher than that of an engine which evaporates 9 lbs. of water per pound of coal. This diminution in the amount of coal burned, of course, implies a less violent draft, as a smaller quantity of coal is burned per square foot of grate per hour; for instance, if the engine evaporating 6 lbs. of water burns 196 lbs. per square foot of grate per hour, the engine evaporating 9 lbs. will only burn 131 lbs. per square foot of grate to generate the same quantity of steam. The less violent draft again implies a larger blast nozzle, which diminishes the back pressure. In many cases in English engines this average back pressure, in numerous diagrams taken at various speeds, never rises above 2½ lbs. per sq. in. In some American engines it will often rise to ten times this amount. If it could be diminished to that of the engine with the large blast nozzle, an addition of 20 lbs. to the square inch would be made to the mean effective pressure; but if we do not want to increase the mean effective pressure, we can, on the other hand, obtain the same power from the engine with a large blast nozzle by cutting off far earlier in the stroke. This again implies a smaller consumption of steam, and instead of using 25 lbs. of steam per I. H. P. per hour 21 will suffice. This diminution in the consumption of steam again diminishes the consumption of coal and cuts it down from 131 lbs. to 110 lbs. per sq. ft. of grate per hour,* or a little over one-half that of the engine with sharp blast nozzles burning 196 lbs. per sq. ft. of grate. Now, it is obvious that here is an exceedingly simple explanation of the smaller consumption of steam, the smaller boiler and the absence of spark arresters found in English engines. It may of course be said that English engines do not haul a big load, but it is a question whether this is not caused more by the exigencies of the traffic department than by any lack of power in the locomotives. A few isolated attempts have been made in England to haul heavier loads, and mechanically it has been done successfully. Trains weighing 700 gross tons have been run at an average speed of 22 miles an hour over undulating gradients by a four-coupled engine, but it was considered by the traffic department that such trains, one-quarter of a mile in length, were too long to handle in switching, and that the time consumed in sidetracking to allow fast passenger trains to pass involved delay to these passenger trains. It is therefore tolerably obvious that little weight need be placed on the argument that as English engines haul light loads at high speeds, therefore their proportions of blast pipe are entirely unsuitable on American engines.

As we write we have before us some particulars of the performances of two engines of very similar general proportions, tractive power and weight, both having similar fireboxes, tubes and amount of heating surface, both running on the same road, hauling the same load over the same heavy gradients, and both handled by the same men. The engine with the large single nozzle consumed about 40 per cent. less fuel in regular service than the engine with the small double nozzles, and also hauled, when tested, a heavier load at a higher speed, and indicated some 16 per cent. more horse power; the reason simply being that with the small blast nozzle the back pressure deducted nearly 20 per cent. from the full effective pressure on the pistons, while with the large blast nozzle the deduction was considerable less.

It is further evident that no spark arrester would be necessary if the consumption of fuel per square foot grate could be so largely decreased that a fire had little tendency to lift, and that any sparks drawn through the tubes were so small as to be extinguished in the smoke arch. Another point has not received as much attention as it deserves. It is only logical to suppose that a high evaporation per pound of coal must necessarily imply a very perfect combustion. Now, very perfect combustion implies a very high temperature; that is to say, the products of combustion are wholly turned into carbonic acid gas and not partly into carbonic acid and partly into carbonic oxide, for the conversion into carbonic oxide generates a far lower temperature than the perfect combustion producing carbonic acid. Now, if we trace the course of a spark from the surface of the fire over the brick arch to the tubes, it is evident that that spark, being surrounded by a very high temperature, will burn far quicker and diminish in size, and finally disappear much more quickly where there is perfect combustion than where the temperature is so low that the spark can gain access to the tubes, little impaired in weight and consequently in velocity, and so passed as a body having some weight through the flues, up the stack and into the atmosphere. Again, a high evaporative duty implies not only a high temperature in the firebox, but a low temperature in the smokebox. It is again obvious that if a spark in its passage through the smokebox is exposed to low temperature, say 600 degrees, which experiments have shown to be about the average temperature in the smokebox of an English engine, it is far more liable to be extinguished before, or soon after, it leaves the stack than if it is kept warm by a temperature of from 950 to 1,600 degrees, which experiments have shown are the ranges of temperature in the smoke arch of American engines. The whole difference lies in the size and proportions of the blast nozzle, and it is significant that so far as we are aware all carefully conducted experiments in this country with single nozzles have proved that the back pressure can be very much diminished and the evap-

* This figure agrees fairly well with the average results obtained in English practice.

orative efficiency of the coal increased, and the amount of coal burned per mile can be decreased. This arises partly from the fact that a single nozzle is a more effective instrument in creating vacuum in the smoke arch than the double nozzle, because the single blast is central with the chimney and acts as a piston driving the products of combustion out before it and creating a more or less perfect vacuum behind it. When the blast is not central and does not completely fill the stack, this vacuum is partly supplied by air which rushes down the stack by the shortest path instead of following the longer course through the ashpan, grate bars, fuel and flues. This is an obvious cause of loss and explains much of the extravagant consumption of fuel attending the use of small double nozzles.

This subject of proportioning blast nozzles undoubtedly presents some difficulties, but there are few subjects in which a little careful experimenting will yield better results. An instance was recently given in these columns where a single exhaust nozzle was enlarged from 4½ in. diam. to 5⅝ in. with a great increase in the amount of vacuum in the smoke arch of an engine burning poor coal.* Many more might be given from the writer's experience, but this suffices as an example of what can be done in this direction.

* See page 450 of the issue of the *Railroad Gazette* for June 17, 1892.

Some of the Results of the West Albany Brake Trials.

Elsewhere in this issue appears such an account as we have been able to compile of the trials made in Karners, West Albany, last September, of the Westinghouse and the New York air brakes. The practical lessons are not as complete and as conclusive as they might be if all the data collected were at hand. But what can be concluded, from what is available, is of real practical value to those who need to know about the essentials of safe train braking.

Before a full appreciation can be had of the meaning of the results of any set of tests of a modern quick acting brake of the emergency type, it is necessary to have in mind what has gone before, that is, what the accepted principles of good braking are, otherwise one shall be in the same situation that everyone was in before the great advance in the art of train braking which took place in 1886 and 1887. This advance was the result of concerted action on the part of all the leading railroads in this country through the medium of the Master Car Builders' Association. The first step was a very exhaustive and remarkable set of tests of all the more important brake systems then in use. The first result of any note that came from those tests was the refusal of the M. C. B. committee to sanction the use on freight trains of *any* existing brake system, the just ground for such refusal being found in the *slow action* of those systems; the most pronounced result of slow action being a serious and damaging shock to cars and lading.

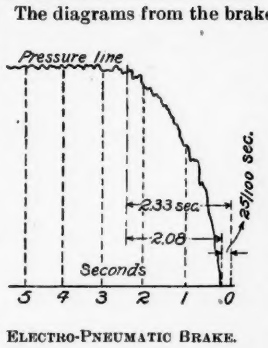
Quick Action.—Probably the most difficult feature of train braking to fully comprehend is the absolute necessity for the quick action of the apparatus. More particularly is it difficult as quick action means only a few (about 3½ and preferably less) seconds from the movement of the engineer's handle in the cab to the time of full application of the brakes on the fiftieth car, about three-eighths of a mile distant from the engine. Any one holding a watch and observing how short this interval is will be impressed with the shortness of the time, and will incline at first to the belief that there is no need for such a rapid action. Such indeed was the belief of all before the practical trials of 1886, and many thought 15 to 30 seconds for a 50-car train was quite quick enough. Yet after a few trials the broken equipment and the bruised and sore observers furnished sufficiently conclusive demonstration that there was not a brake system in existence that was at all adequate for long freight trains.

Most of the competitors came to the conclusion that long trains, regardless of the speed, required such instantaneous action of brakes throughout their entire length that air was too sluggish, and that a trial of electricity must be made. This evidence was so conclusive that electro-pneumatic brakes were made and tried, and for the time being purely pneumatic brakes were dropped from consideration by most people. The trials of the electro-pneumatic brakes gave such satisfactory results, and the shock was so completely removed, that the brake committee, composed of some of the best practical railroad men in the country, reported to the M. C. B. Association that the only safe brakes for 50-car trains were probably those set in action by electricity. All know the repugnance which exists in the minds of railroad men to the use of electrical devices for railroad trains, and this illustration will show the great need for almost instantaneous and simultaneous action of brakes on long trains was realized.

But Mr. George Westinghouse was not dismayed and after many experiments succeeded in making each brake in the train assist in applying the succeeding brakes just as in a row of bricks, each knocks down the next in the row. The resulting action was not equal in quickness of application to the electro-pneumatic brake, but it brought the wholly pneumatic brake just within the admissible limits by reducing the time of action to about 2½ seconds from the front to the rear car of a 50-car train. The action of the electro-pneumatic brake was practically simultaneous throughout the train.

So much for the practical evidence of the need of quick action. The mathematical, or rather theoretical, evidence is even stronger. Shock is caused by the rear of the train running unbraked, while the front of train has the brakes applied. This causes the rear to run into the front with more or less force, according to the difference of time between the application of brakes at the front and rear. In each second a train at 40 miles an hour runs 59 ft., and in three seconds 177 ft. If the front of the train should stop instantly and the rear continue to run at 40 miles an hour, the effect would be, after about one-half second interval, equal to a rear end collision at about 40 miles an hour. But, in fact, the front of the train keeps on running after the brakes are applied, but meanwhile is slowing so that there is a difference in speed between the front and the rear, and the shock generally occurs about six seconds after the brakes are applied at the front. During this interval the train has run about 250 feet. The shock is thus dependent upon the decrease of the speed of the front of the train below that of the rear before the rear runs into the front, and the only way to reduce the shock is to decrease the number of second's interval between the application of the brakes at the front and at the rear. At the present time brake designers are trying to decrease this interval by as little as one half a second.

The diagrams from the brake cylinders given in another column show the time of action of the Westinghouse and New York brakes at the West Albany trials, and these should be compared with the following diagram to see their correspondence with the electro-pneumatic brake which gave such satisfactory results. It will be noticed that the electro-pneumatic brake acted very much quicker than the others, but was slower in gaining full application than the Westinghouse. The comparative figures are as follows:



ELECTRO-PNEUMATIC BRAKE.

	Start to go on at rear.	Full on at rear.	Time from start to go on to full on.
Electro-pneumatic	0.25	2.33	2.08
Westinghouse	2.81	3.73	0.92
New York	3.33	6.20	2.87

The time in this table is reckoned from the instant of the movement of the engineer's handle in the cab, except for the last column, and is given in seconds.

Uniformity.—What made the electro-pneumatic brake a success in this one feature was the simultaneous application of all the brakes throughout the train and the further important advantage that the valves were all alike *in the time of gaining full application.* If the rear valves, although starting to go on simultaneously, had been slow in action, and the front ones quick, then there would have been serious shocks. Not alone is it necessary to have simultaneous starting of brake application, but uniformity of application must also be had, and these essentials have forced the M. C. B. Association to select a standard of brake action so that there may be practical uniformity. In this way alone can the results of the labors of the Association in determining what is a safe brake be made of real practical value for a country where cars are interchanged. If the experimental electro-pneumatic valve used at Burlington and the present Westinghouse triple valve were used in the same train and all were operated by electricity so as to get simultaneous starting, then there would be shocks if the Westinghouse were at the front, for the reason that *full application* is reached quicker with the Westinghouse than with the electro-pneumatic. The action would be about this: All brakes would start to go on in about .25 seconds; the Westinghouse would be full on at front at 0.90 seconds later and the electro-pneumatic would follow at the rear 1.18 seconds thereafter. This results from the slower action of the electro-pneumatic after it is once started. The times for the application period of the two brakes are 0.90 seconds for the Westinghouse and 2.08 for the electro-pneumatic.

Take the case in point, the trials at Albany: If 25 Westinghouse brakes had been put at the front of the train and 25 New York brakes at the rear, then the front brakes would have all been full on at the end of 2.42 seconds and the rear full on at the end of 5.92 seconds; and it may reasonably be supposed that the shocks with such an arrangement of brakes would have been very considerable. This all goes to show why the air brake committee of the M. C. B. Association has laid so much stress upon the need of uniformity of action as well as simultaneous commencement of application throughout the entire train. It is the need of uniformity that has led to the requirement that new brakes shall practically duplicate the action of the Westinghouse, of which so many are in service.

If all the slow acting brakes could always be put at the front the shock would be removed and instead there would be an extension of the couplings, as the front of the train would tend to pull away from the rear. This would, however, cause such a severe strain on the couplers as to cause them to part, as they did at the Burlington trials last year. It is quite easily seen that by mixing brakes having slow with others having quick action in the same train, shocks would result in some sections and tension in other sections of the same train. Of course this is the result when the same quick-acting brake is put on all cars of a mixed train of loaded and unloaded cars, but this last it is impossible to avoid, while the first can be avoided by the exercise of such care in designing and selecting brakes as to give them the same standard action, and this is what the M. C. B. Association is aiming at. It may be well to note here that when a train breaks in two parts the reaction of the draft springs causes almost as much shock as when, owing to the non-uniformity of action of the brakes the rear section runs into the front.

The conclusion then is: There will be shocks of a dangerous degree whenever there is non-uniformity of brake action no matter what be the origin of the irregularity, and damaging shock can only be avoided by giving all brakes the same standard time and force of action.

Shock.—Twelve inches of shock, as shown by the slidometer, has been pronounced harmful by the M. C. B. Association. The words of the committee of practical men are: "Shocks in ordinary handling of trains with slack couplings over sags, hog backs and working in yards will move the disc from 2 to 8 in.; 12 in. has been estimated as sufficient to be injurious to live stock and equipment. Repeated blows of 12 to 20 in. in the mixed and loaded car tests were sufficient to start the loads at the rear of the train through the ends of the cars; the loaded cars thus, through the movement of their loads, becoming a check in weighing the length of the slidometer movement that was admissible and inadmissible." In the following table we give the shocks measured at the West Albany trials. It must be borne in mind that the M. C. B. committee found the shocks in ordinary working, resulting from other causes than brakes, to be 2 to 8 in., and that a 12-in. shock is inadmissible.

SLIDOMETER MOVEMENT—INCHES.

Mixed brakes.	Westinghouse.	New York.
10¼	4	26½
23⅛	½	31
....	½	28¼
...	6	26½
Averages	2¾	28 1/16

One fact of importance was clearly defined by the mixed train tests. Where the cars of the Westinghouse and New York trains were mixed in the same train, both the length of stop and the shock were found to be not only intermediate between those of the two systems, when used separately, but almost exactly mean proportionals between them. This indicates that the mixing of quick application brakes in the same trains with comparatively slow application brakes improves the action of one and impairs the efficiency of the other according to the numbers of each in the train. It should be noted that the "break-in-twos" were increased in the mixed trains.

Cutting Out.—Another matter of equally great importance brought out by these trials, and one that has a direct practical bearing, is the effect of cutting out defective brakes in a train when such brakes are adjacent. It is common to find brakes defective, and equally common to cut them out of use, hence the importance of a knowledge

of the results during an emergency application. In the Albany tests the results were as follows:

	Three Consecutive Cars Cut Out.	Delay of Rear Application Caused by Gap—seconds	Maximum interval betw'n commence'nt of application on first and fiftieth cars.
New York......	Emergency passed gap in 2 out of 5 trials.	.63 and 1.13.	4.20
Westinghouse.	Emergency passed gap in 3 out of 3 trials.	.09	2.70

It cannot be doubted that very great shocks would occur upon a 50-car train with 4.20 seconds interval, as given in the foregoing table, and in view of this greatly increased time of application, when some brakes are cut out (this is probably a new fact to every one), it would seem to be very important that, in future brake trials, running tests should be made with two and with three consecutive brakes cut out of service. The Master Car Builders' committee have stipulated that brakes must be susceptible of sure application with three consecutive brakes cut out; but it would appear to be equally important that, with three consecutive brakes cut out, the emergency action may be had without destructive results to the train or its lading, as it will frequently happen that as many as three consecutive brakes are cut out.

Length of the Stop.—The avoidance of shocks is of great importance, but not less so is the attainment of the minimum practical length of stops. A train running at 40 miles an hour travels over 59 ft. in each second, and the loss of a second in applying the brakes means that 59 ft. more will be traversed than if the second had not been lost. After an engineer sees danger ahead, it is not more than one second before he instantly applies the brake, that is, supposing him to be a trained man running an important train, hence the loss of one second in application of brakes, due to the brake itself, after danger is discovered, is a large comparative loss. At a point 59 ft. before reaching a dead stop, after an emergency application at 40 miles an hour, a train would be travelling at about 20 miles an hour. This means that a saving in this case of 59 ft., or one second of time, reduces the outcome of a dangerous situation from a certain rear collision at 20 miles an hour, to the probability of no collision at all.

There are many other ways of reducing the length of a stop besides the reduction of the time of brake application, but nearly all of these have been utilized to the fullest extent that now appears practicable. The adjustment of the braking force in proportion to the load is one possible way, but it now seems to involve so much complication as to be impracticable for general use. Greater air pressure can be used during the first part of a stop at high speeds, but this, while now being perfected for very high speed express trains, involves so many additional functions as to prohibit for the present its use on freight trains. So that having increased the brake leverage all that it is safe to do, there remains only the reduction of the time of application, as a means of decreasing the length of stops. The average equated stops and time of full applications at the Albany tests were as follows:

	Length of stop.	Time of full application.
New York..................................	383.8 ft.	6.19 sec.
Westinghouse..............................	324.2 "	3.71 "

The stops of the New York train average about 60 ft. longer than those of the Westinghouse train, at a speed of 30 miles an hour. This is a difference of 18.4 per cent., which, in a case of emergency might very often prove an abundant margin in which to prevent a disaster, as before explained. A full analysis of the diagrams shows that a portion of this difference is due to the slowness of full application throughout the train. Another portion of the difference may have been caused by the fact that the brakes would not remain fully applied, but were diminished in their force of application by leaking off. The failure of the brakes to remain applied for a reasonable length of time may be a serious matter—especially as it does not appear to have been due to leaky piston packings but to a failure of the triple valves to retain the air in the brake cylinders. Upon heavy grades this would prove to be an element of serious danger, and in the case of a parted train upon a grade, if the brakes of the rear section released themselves, a collision between the sections could hardly be averted.

Leakage and Release.—The matters of leakage and release were not settled by the Albany tests. The tests were not repeated sufficiently to get duplicate results, though on the whole there is evidence of considerable leakage. In discussing this it is necessary to know that brakes may be divided into two classes, (a) those having independent release feature and (b) those having the release dependent upon other features.

In the New York brake the spring which controls the emergency must do work in pushing back a piston having airtight packing before release can take place. If the spring is made stiff enough to make release certain under service conditions, there is the great probability that the quickness of emergency application will be interfered with. And on the other hand, if the spring is weakened the emergency action is bettered, but then the release is liable to be uncertain and may not take place on long trains in cold weather when the valves are stiff or when the valves are dirty and "gummed." In the Westinghouse brake the release is independent of the emergency spring and depends only on the tightness of the piston packing.

Release is assisted by certain kinds of leakage. If the brakes leak off they will be released at a lower pressure than if they remain tight. Therefore, as the tests for leakage were quite meagre and non-conclusive, it only remains to be said that there was evidence of much leakage in the New York brakes, but how much or of what kind no one knows.

General Considerations.—The behavior of the Westinghouse apparatus in these tests developed nothing especially new or different from the results of many former trials. The action of the New York apparatus was in some features strikingly different from that shown before. It will be remembered that, in the Lehigh Valley brake trials, nearly a year ago, the New York brake stops were nearly as short as those of the Westinghouse, the shocks were slight, and the only serious difficulty disclosed at that time was the inability of the brakes to release. At the Albany trials the New York brakes released with great promptness in all cases: but the stops and shocks in every case compare very unfavorably with those made before with the same brake; hence, as the emergency and release features of this brake are interdependent, as before explained, it may be that the makers, in an effort to remove the cause of the non-release in former trials, have made changes in their apparatus which sacrificed the quick action feature and tightness. However, as we have said before, the test for leakage and release were so incomplete as to leave no clue to the real comparative practical value of this feature of the brakes tested.

Outside of comparative brake action and the more practical lessons of these trials, there are other deductions of scientific interest. Take for instance the mixed train and note the comparative length of stops and amount of shock. It will be seen that, at 30 miles an hour, the New York train requires 59.6 ft. more distance in which to stop, which is 18.4 per cent. of the whole length of stop of the other train. It would naturally be expected that with this difference the mixing up of the two systems in a train would produce results somewhat intermediate between those found for the two trains taken separately, and it is not a little interesting, therefore, to compare the average of the results of the uniform train tests with the results of the mixed train tests. The average of the stops of the Westinghouse and New York trains is 354 ft.; the average of the mixed train stops was 351.5: the average of the shocks of the Westinghouse and New York trains is 15⅝ in.. and the average shock of the mixed train is 16⅞ in. Thus the averages nearly correspond and give emphasis to the reliability of the results from this portion of the Albany tests.

The results of stop No. 5, with a full service application, are also interesting. The New York train traveled, in making this stop, 113.5 ft. farther than the Westinghouse train, although the Westinghouse train had but a pressure of 68 lbs. in the train pipe, while the New York train-pipe pressure was 70½ lbs. There is no safe way of making an accurate reduction of the lengths of service application stops to a uniform basis, and it is therefore impossible to show the exact relation of the service stops of the two trains. It is evident, however, that with the higher train pipe pressure the New York train should have stopped in a shorter distance than it did. It is difficult to account for the difference in the lengths of the service stops in the two cases. The reduction of the air pressure was made absolutely identical in both cases, and if the brakes on the two trains were air tight and the graduation features equally perfect then the stops should have been nearly identical. The difference may perhaps have been caused by the leakage of the brake triple valves, which would reduce the braking force so much that the stops could not be as short in one case as in the other. This is another reason to regret that the "holding on for down grade" tests were not fully carried out. The tests of this sort that were made showed that about one-fourth of the New York brakes failed to apply, but such tests need several repetitions to be conclusive.

Strikes or No Strikes?

There is no other occupation, wherein so many persons are employed, in which so much intelligence is required, and where, as it would seem, there is so much intelligence in actual use as in the business of railroading; account being taken of the high character, knowledge and judgment to be found among the managers of the various departments, and of the skill, courage, sobriety and trustworthiness of the immense body of railroad employés. And because this superior intelligence is generally admitted, and is certainly not doubted by those who are engaged in railroad work, it becomes difficult to understand why strikes and rumors of strikes are so constant upon railroad lines—not only here but elsewhere—although various other trades have found out means of arriving at easier and wiser adjustments of differences. Probably this admitted superior intelligence has resulted in an exaggerated self-esteem, afflicting both sides of the dispute, the managers and the men, rendering it very difficult for either party to accept any view but its own; for we suppose that one of the chief distinctions which marks the progress of mankind in civilization is the abandonment of personal conflict and the acceptance of the decision of a duly appointed arbitrator, judge or cadi, in lieu of private judgment; and some such method of securing quiet and the continuous operating of great railroad systems would have been sought and found if personal vanity in some form had not stood in the way. It is certainly not too soon to expect that the railroad body should seriously endeavor to avoid the disastrous strikes which have disturbed the peace of the entire nation. Of course managers may be the victims of conspirators, but they will not be such if they maintain cordial relations with the honest portion, which is the larger portion, of their men, most of whom desire peace as much as their officers do.

An important mass of useful information upon the subject of how to harmonize wages disputes and other conflicts between employers and employed, is to be found in the testimony taken by a recent English parliamentary commission on labor, which has been published in advance of its completed report—and which should be interesting to labor leaders and to labor managers.

From the volume it appears, that among the earliest successful efforts in England at avoiding strikes was the appointment of permanent boards of conciliation, composed of representatives of employers and of delegated employés, who met regularly and as often as any occasion arose, to talk over alleged grievances or any subjects of complaint, and to agree upon such measures as would remove any cause for just complaint. It was found that these frequent meetings inspired mutual confidence in the good intentions of all parties, and resulted in a harmonious settlement of differences of all kinds, even as to prices. Such boards of conciliation proved useful in the coal trade, in the hosiery trade and others.

In 1869 a board of arbitration for the manufactured iron trade was established and is still in existence, having rendered strikes in that industry entirely unknown, although before the formation of this board they were very frequent, as would be expected from the rapid fluctuations in prices due to the changes in demand and in methods of manufacture. Other trades, as for instance, the puddlers, have adopted both the board of conciliation and the board of arbitration, which now practically control the wages of that trade in all the North of England and in Scotland. Many firms of employers are not represented in the board, but they always adopt the board's rates. It is stated that since 1869 this board has made 60 general settlements of wages, 20 of which have been decided to mutual satisfaction by a single outside arbitrator, some well known public man like Judge Hughes or Joseph Chamberlain.

Two rules of peculiar value are in force under these arbitrations; first, there shall be no suspension of work before the cause of dispute has been submitted to the board; second, the board's decision may be retrospective, taking effect at the date when the matter was submitted. When the decisions have been against the men they have paid back the surplus wages which they have received during the pendency of the question. There are some trade associations which have a fund reserved, out of which to repay any such surplus which the employers may have paid; and they further guarantee the performance of the trade agreement with the employers. One of these, the "Boilermakers and Iron and Steel Shipbuilding Society," has a membership of 37,000.

It is found to be very important to have the promptest possible decisions in the arbitration cases, in order to have both sides satisfied; but where this promptness has been secured there have been very few objections to the decisions. In many trades where the board of conciliation or the board of arbitration, or both, have been adopted there has been no strike for periods of fifteen, twenty, and even for twenty-six years, that is, since the date of the first formation of the committee of conciliation for the hosiery trade.

From even this brief summary of the most important evidence taken by the labor commission it will be reasonable to conclude that when the employers and employed are willing to meet each other and talk over the questions at issue frankly, they can almost always arrive at a settlement without a strike or a lockout. If, however, the employer persists in assuming the attitude

of absolute master he will be met by a like obstinacy in resistance. There is a mistaken opinion on the part of some railroad officials, which arises from their just appreciation of the necessity for subordination and obedience on the part of employés, that they alone should decide *all questions*, as they feel prepared to do, without any doubt as to their own fairness. These gentlemen forget that while they may be autocrats as to discipline, when questions of wages or of personal comfort or treatment arise, the employé is upon the same level with the employer, and entitled to be met and treated with as an equal; and the employé feeling this deeply, as every freeman should, is often fired with the spirit of Bunker Hill and Lexington, when an insolent official in his state of self complacency does not suspect what can be the reason the other is so excited.

We have had many illustrations in this country of the pleasant manner in which wages disputes may be settled, when the parties concerned have met each other in a manly way and discussed the questions at issue upon equal terms, and the experience in Great Britain seems to amount to a positive demonstration that strikes are as unnecessary as war between nations, for if good manners and reasonable discussion cannot settle the dispute, arbitration will do so effectually without loss to either side. The existence of an agreement or understanding that any controversy shall be referred to an arbitrator is of itself influential in making both parties to it inclined to be reasonable, for neither can gain anything by unreasonable proposals. There exists a suspicion that an arbitration implies only a compromise or "splitting the difference," yet it is not justified by experience, especially when only a single arbitrator is chosen. Where there are three arbitrators a compromise between them may be necessary to a judgment, whereas one man of fearless character will generally arrive at the right conclusion after a proper hearing.

Our old friend, or perhaps we should say our young friend, the "lady engineer," has started again on her travels, through the columns of the daily press. The New York *Sun*, one of the most skillful finishers of fake news, printed the following on a Monday morning, when space for romance is always available:

CAIRO, W. VA., Feb. 10.—Miss Ida Hewitt, who is the only female lonomotive engineer in the world, has been engaged by the Woman Commissioners of the World's Fair to run the first train over the grounds on the opening day of the Exposition. She will leave here for Chicago about a week before the opening day. She is a pretty girl, and will wear the costume of a Spanish girl of the fourteenth century. In reply to a proposition made to Miss Hewitt to become a member of the Brotherhood of Locomotive Engineers, she replied that while she could not find it in her heart to become a brother to them she would be a sister as long as she lived. The Commissioners are said to have had a great deal of trouble inducing her to run the engine at the Fair. The road upon which Miss Hewitt is now running regularly is the Cairo & Little Kanawha. It is owned mostly by the girl's father, a man of wealth. Her calling does not make her unwomanly. She is popular socially and is a model housekeeper.

We are both pained and pleased; pained at the lack of model housekeeping in West Virginia, which will result from this wicked scheme of the Woman Commissioners, and pleased that Ida's father has got rich. When she appeared before the world before, the story of his wealth proved to be unfounded, but now, being in the *Sun*, it must be so. Who will tend Ida's pump house while she is gone? It cannot be that Mrs. Potter Palmer wanted a runner at Chicago so badly as to offer to fill the stationary position herself. Again, why take Ida to that wicked city so long beforehand? Probably they have filled her head with vanity, and she is going to make a triumphant procession of herself all the way out. We wish we knew how Spanish girls dressed in 1350, but we do not, and our readers must put up with the item as it is. For ourselves, we should prefer the "natty cap" which she wore in the former picture (word picture), to any of the miserable toggery of the middle ages. We understand that the Woman Commissioners will receive bids up to Feb. 22, for filling the position of fireman on the "first trainover the grounds."

The committee of the Illinois Legislature appointed to investigate the disaster at Wann, Jan 21, has made a report, which is printed in the newspapers. It seems to have been inspired largely by prejudice, but there are just enough allusions to facts to show the necessity of an impartial investigation by a competent body. It is stated that the switches were in charge of two yard brakemen who had been at work only 24 days, and that they had had no previous railroad experience; and further that the conductor or yardmaster over them was a new man. But nothing definite is given about the actual character or habits of the man (Gatten) who is held responsible for leaving the switch wrong. He is sneered at as having been a barber, but if we remember correctly the evidence showed that he had worked on a railroad before; and the real question, so far as he is concerned, is whether he understood the gravity of his responsibility as the custodian af a main track switch. The report deals mostly in generalties, as will be seen by an extract from the closing paragraph:

"The proof also shows that for the last two years the road has failed to keep any crews in said yard long enough for them to become competent to manage said yard properly, but changed its men so often that the crews were always composed of more green and incompetent men than anybody else, and many of them without sufficient mental ability to ever become competent, and that the management made no reasonable effort to keep competent men, but showed a decided preference for green men, until the yards became a kind of kindergarten for them, and they were put in charge of important places upon their second day of railroading, to the danger of all trains running through said yard."

A report containing that kind of talk is of no value unless it is accompanied by full and reliable evidence of the things charged. If the charges are true the managers of the roads should be indicted, while if they are only the vaporings of a political committee the report is a disgrace to the State of Illinois.

The storms and floods of last week were even more widespread than was indicated by the reports received up to the time we went to press. The usual minor damages to bridges and highways and to buildings near the large rivers were reported from all points, but definite reports of unusual damages at any particular point were comparatively rare. At Cincinnati the river rose to 53 ft. or higher. An iron bridge of the Georgia Pacific at Grenada, Miss., was badly wrecked by the undermining of a pier. The track of this road was under water for many miles, and a number of other bridges were weakened. Near Upton, Pa., an iron bridge of seven spans was much damaged by floating ice. Two bridges on the Toledo, Peoria & Western, near Peoria, Ill., were dislodged. The Fitchburg road lost an iron bridge near Pownal, Vt. The country northwest of Chicago was visited by a severe snowstorm, with low temperature, the latter part of last week, and the first of this week there was very low temperature, with some snow, in New York State and other parts of the East. The South was also affected by the cold wave, though not so severely as in January. Northern New York and New England had another severe snow storm Feb. 22.

The Queen City Railroad Clerks' Association, of Cincinnati, which now numbers about 150 members, seems to be more than usually enterprising for an organization of this kind. Some of the principal members have lately been working up interest among other classes of railroad employés, and have also secured promises from a number of railroad officers and others to deliver addresses at the meetings of the Association. These addresses will include descriptions of different departments of railroad work, for the benefit of men who work in other departments, and also sketches of European railroad practice and other appropriate topics. This would seem to be a very judicious plan for conducting such an association. While the social feature of a body of this kind ought to be prominent, and the inclination to "talk shop" should be duly repressed, it will, nevertheless, be a good thing to introduce subjects with which all the members are measurably familiar, to make sure that the ice is thoroughly broken. It is a great deal better to begin "talking shop," and end with common sense on other topics which will naturally follow, than to begin with art and literature and end with an empty hall.

It is reported from Topeka that George M. Howell, of the Howell Lumber Company, of Atchison, convicted of violation of the Interstate Commerce Law in the United States Court at St. Joseph last December and sentenced to imprisonment for a year, has had his sentence modified by the President. The fine of $1,000 is not remitted, but a pardon is issued relieving Howell from imprisonment. Offenders against the secret-rate prohibition of the Interstate Commerce Law cannot as yet complain of any excessive severity in the law. The only two convictions of any consequence on criminal indictments—this one and that of the Michigan Central officer—have both been softened down to such an extent that the only real punishment has been the notoriety due to the publication of the trials and the anxiety engendered by the shadow of the jail. Perhaps, however, this was enough.

NEW PUBLICATIONS.

Theory of Structures and Strength of Materials. By Henry T. Bovey, Professor of Civil Engineering and Applied Mechanics in McGill University, Montreal. New York: John Wiley & Sons; 1893. $7.50.

One of the most important functions of a professor of engineering is to render plain and clear to students the principles of mechanics as applied to structures, so that their application to numerical problems may be quickly and correctly made. Moments of inertia, shearing forces, bending moments of forces, resisting moments of internal stresses, elasticity, coefficients, and all the other paraphernalia of the science of mechanics, are slowly grasped by the average mind, and their correct application in either algebraic or numerical operations can only be acquired after much thought, toil and struggle. The numerous books on materials and structures indicate that the professors are working hard to impress principles and methods upon youthful minds, for we infer that a new book exists by virtue of the reason that each professor discovers in his class-room experience new ways of illustration, shorter processes of demonstration, or more satisfactory arrangements of argument, whereby the toils of students may lessened. By teaching we learn, says an ancient proverb; young minds react on that of the teacher, and thus it is that new text-books are born.

A few years ago Professor Bovey published two small volumes of notes for the use of his classes, and these form the foundation of the present work, but the subject matter has been augmented and revised so as to make it almost a new book. It is an octavo of 832 pages, printed on fair paper, and with the handsome brown binding that marks the recent publications of Messrs. Wiley. There are 507 cuts, a large number of problems for solution by students, several useful tables, and of course many formulas. It is a fault common to nearly all books of this kind that a great deal of unnecessary blank space is left above and below each line of algebraic formula; this will probably always exist as long as printers receive pay for such space at the same rate as type. Another fault, which must be ascribed to the author, is the very frequent use of italics to emphasize words and phrases. In a lecture such emphasis is both proper and necessary, for the meaning of a sentence must be quickly caught by the hearers, but in the permanent printed page where the eye can travel at leisure over the lines these optical roars seem out of place.

The first and second chapters constitute an elementary course in graphic statics, with applications to roof trusses and to beams. Then come three chapters on general principles of stresses, strains, materials, retaining walls and friction. The strength of beams, columns, shafts and boilers occupies five chapters. Common and cantilever bridges, suspension and arched systems fill the three concluding chapters. The book sets forth the principles and methods for the investigation of the stability of structures and for the computation of stresses, but the subject of the design of roofs and bridges is not taken up specifically. It is probably well that this should be so, for what a student can learn at school about the design of special bridge details is of small importance compared to a comprehensive and thorough knowledge of the science of mechanics. On a broad and solid foundation, such as this book gives, the student will be able to build high, for the principles which control the design of special structures will be at his ready command.

While the book in general appears to be an excellent one, and exhibits much thorough and painstaking labor on the part of the author, it seems to us that some subjects are not set forth as clearly as might be. For instance, in the theory of the flexure of beams, the argument begins with the curvature, and the internal resisting moment is deduced in terms of the radius of curvature and then in a special example in one of the corrolaries the fundamental formula giving the relation between internal and external moments is brought out. Now this formula is by far the most important thing in the theory of flexure, being the basis of 99 per cent. of all the practical computations, and hence its deduction should be made in a direct and forcible manner, rather than in an indirect and indefinite one. The reason why the modulus of rupture is intermediate between the tensile and compressive strengths of the material should be well elucidated, and this important constant should not, as on page 348, be called "modulus of rupture" in one paragraph and "coefficient of bending strength" in the next. We are unable to agree with the author's views on page 349 regarding the distribution of stress in a beam when the elastic limit is exceeded; if we understand him aright he states that when a beam is about to break, or in "a state of perfect equalization," all the fibres on one side of the neutral axis are equally strained in tension, and all those on the other side equally strained in compression.

The author sometimes uses algebra too freely. After devoting several pages to Rankine's theory of earth thrust, he dismisses it with the remarks that the thrust given by the formulas is too great, and that in deducing it an "altogether inadmissible assumption" has been made. Four pages of algebra are required to deduce the moment of inertia of a double-tee section with rectangular flanges, all of which is elementary work that might better have been done by the student. Three pages, nearly, are devoted to developing the equations of the catenary curve of a cable, and the subject is then dropped with the remark that these "are of little if any use," and the discussion of the parabolic curve is begun as should have been done at the outset. In a work on pure mathematics the formulas for the catenary would have been proper and valuable, for they beautifully illustrate the principles of hyperbolic trigonometry, but space should not be given to them in a book on structures if they are of no use. A new formula for columns, involving elliptic integrals, is deduced by Professor Bovey, but as numerical discussions of it are not given, we cannot express an opinion as to its value.

Young engineers as well as students will be greatly benefited by the careful reading of this text book, especially if they solve the examples given after every chapter. There are good tables showing the experimental results of tests on materials, and one of particular value giving weights of many bridges erected in the United States and Canada. On methods of computing stresses due to wind and live load the author is sound and clear, and numerous remarks regarding shocks, workmanship, efficiency and economy, tend to harmonize theory and practice.

Atmospheric Resistance and Its Relations to the Speed of Railway Trains, with an Improved System of Heating and Ventilating Cars. By Frederick U. Adams, Chicago Tribune Building, Chicago. 1892.

The keynote of this work is the author's fixed belief that "atmospheric resistance is the all predominating factor in the total of train frictions." The author urges with every appearance of conviction and by the aid of

numerous well executed diagrams and pictures of ancient and modern trains flying through simooms, tornados of visible air, and other regions unknown to the general passenger agent, that a new system of car construction is necessary to save the railroads from bankruptcy and the population from slow extinction by the continued increase in railroad accidents. The theory that atmospheric resistance has anything to do with railroad accidents is novel and should be very consoling to the brakeman who has moral objections to flagging, and the engineer who considers that these new-fangled signals are a nuisance anyhow, and deserve a little occasional look-the-other-way-as-we-pass-by contempt on his part. Old-fashioned railroad men have long been under the delusion that the train ahead is the great obstacle to high speed, but Mr. Adams proposes to change all such old fogey ideas.

In a recent issue of the *Railroad Gazette*,* an analysis of indicator diagrams taken from various high-speed locomotives showed conclusively that the resistance at high speeds is not so formidable as supposed, and that it never equals the total resistance of a train in good condition when ascending a one per cent. grade at a slow speed. A diagram in this issue gives the indicated horse power required at different speeds with a New York elevated train ascending a two per cent. grade. The increase of power required as the speed increases is very noticeable. As the amount of steam which the boiler has to raise in a given time depends wholly on the indicated horse power, it is very evident that a mere increase of speed on a grade—and this is essential to fast running—is a formidable tax on the steam-generating power of a locomotive even if no such thing as atmospheric resistance existed.

Mr. Adams proposes to box up the locomotive and entire train in a manner somewhat similar to that usual on "dummy" locomotives working on crowded streets. While there is no general objection to such a plan, though many difficulties are manifest in working out the details, it has probably escaped Mr. Adams' attention that his method would, on the whole, considerably increase the atmospheric resistance. Granted that it would be reduced when the train was running against a wind dead ahead, it is obvious that such a condition rarely occurs; the wind, as on shipboard, can seldom be exactly opposed to our course. And, unlike the conditions on a ship, a beam or side wind is generally considered by old locomotive runners to be a more formidable obstacle than a direct head wind. In the first place, it drives the whole train literally against the lee rail, thereby much increasing the flange friction; and, secondly, it makes the engine steam badly, because the ash pan does not get a proper supply of air. Mr. Adams' method by increasing the side area of the train would largely increase the first cause of increased resistance and would do nothing to diminish the reduction of power caused by the second effect of a side wind.

It must not be forgotten that a locomotive running at high speed is developing a greater horse power for its weight than any other known form of steam engine and boiler. Even the fastest torpedo boat engines weigh more per I. H. P. The mechanical obstacle to high speed with heavy trains is that it is difficult to still further increase this superiority and make every ton weight of locomotive develop more horse power. The use of higher pressures and compounding, and the fact that greater weights can be safely placed on each pair of wheels have recently somewhat increased the speeds mechanically possible, but though nearly 100 miles per hour has been attained in a mechanical sense, it could not be sustained. Why? Because there was a coal train ahead.

The most effective argument which Mr. Adams uses to prove the great influence of atmospheric resistance is the following interesting table of the coal consumption per passenger car-mile on the Chicago, Burlington & Quincy:

Date.	Coal, per passenger car-mile, lbs.	Average velocity wind for last five years, miles per hour.
1890—December..	14.52	9.75
1891—January....	15.05	9.69
February...	15.41	16.13
March......	15.53	10.97
April	13.66	10.13
May	12.04	8.88
June........	11.83	7.95
July........	12.16	7.28
August.....	11.51	6.91

The explanation that would suggest itself to any ordinary person would be that the coal consmption is greatest in cold weather, which involves radiation, snow drifts and delays, while in warm weather travel is increased, meaning a larger number of cars per train and therefore a decreased consumption per car. Allowing a consumption of 20 lbs. per mile for the locomotive to overcome its own resistance and 6 lbs. per mile for each car we obtain the following figures.

Number of cars in Train.	Total coal lbs. per mile.	Coal per car-mile.
5	50	10
6	56	9.33
7	62	8.86
8	68	8.25

This cause alone would very largely explain the real reason of the diminished consumption shown in the table Mr. Adams quotes.

A Bibliography and Priced Catalogue of Early Railway Books. Edward Baker, Bookseller, 14 and 16 John Bright street, Birmingham, Eng., Price 6d.

Mr. Baker's little catalogue contains 194 titles of books and files of old railroad magazines, maps, etc. The collection is a very good illustration of the history of railroads in England from 1824 to 1860, with some excursions into America and Belgium. The catalogue contains descriptive notes which add much to its interest and value. The whole collection is offered for sale complete, or each lot will be sold separately. Some of the books and documents collected are extremely rare.

* See pages 210 and 211, March 18, 1892.

The Nicaragua Canal.

LONDON, England, Feb. 1, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I received by last post a copy of your valuable issue of Jan. 15, containing an article entitled "The United States and the Nicaragua Canal." Your objection to the present project and estimates may be summarized under the following heads:

1. One unfavorable report suppressed by promoters.
2. Excessive and destructive rainfall.
3. Insufficient allowance for enervating effect of tropical climate.
4. Geologcal formation unfavorable.
5. Treatment of physical conditions radical in extreme.
6. Unprecedented number and size of embankments.
7. Difficulties in constructing Ochoa Dam.
8. The stupendous size of Divide Cut.
9. Silting.
10. Impracticability and cost of opening harbors.
11. Inadequate cross section of canal.
12. No allowance for towing sailing vessels.

It is to be regretted that you were not more specific in your objections and criticisms, but I will try to throw some light on the so-called doubtful questions and unfavorable conditions specially pointed out, hoping that by so doing other problems hinted at as unsolved, or of difficult solution, may be brought forward with all their objectionable features for discussion.

(1.) The article dwells upon the fact that all the favorable reports have been printed and spread broadcast by the Government and the company, but that one report "seems to have been considered unsuitable for distribution, and the apparent reason for so considering it was the excess of some of the estimates over those made by the engineers of the promoters." I have always tried to keep myself posted in matters relating to this project, but I must admit that on this point my information is deficient. I have no knowledge of such a document. It would be both proper and desirable for the *Railroad Gazette* to publish such report, or at least the author's name and the date of his examination, which, of course, must be subsequent to 1885, for the present project had a birth no more remote.

Major W. McFarland, of the Corps of Engineers, Prof. Henry Mitchell, of the Coast Survey, and General Jabob Ammen, all submitted reports to the International Canal Commissioner of the results of an examination made in 1874 of the Nicaragua and Darien routes, and these reports were transmitted to the President of the United States on the 7th of February, 1870, but none of the documents in question within my knowledge have ever been published. Some years ago a newspaper claimed to have secured and printed a copy of McFarland's report, but I have no means of judging as to its correctness. The Senate has recently called up the Secretary of War for a copy of the missing, or so called "suppressed," documents, and I trust they will be unearthed. I know that General Humphrey and Admiral Ammen, both members of the Commission, made earnest efforts to procure a publication of all the manuscript inclosures, but while the original report of the Commission was in 1879 still preserved, none of the subordinate repoats could be found, nor does a copy appear to have been filed in the Engineering Bureau. But none of these papers would have been of any special value, for the line then under consideration was designated by General Humphreys to his subordinate as an "approximative" and bearing but slight resemblance to that now under consideration. Some of the characteristic features of the earlier project as compared with the present are as follows:

	Project 1872.	Project 1890.
Total length ocean to ocean.........	181 miles.	169 miles.
Part in excavated channel..........	62 "	27 "
Part in slack water navigation.....	119½ "	142 "
Number of locks proposed...........	21	6
Length and width of proposed locks.	70 × 400 ft.	80 × 650 ft.
Average lift of locks................	10¾ ft.	36 ft.
Height of summit level..............	107 ft.	110 ft.
Depth of canal........................	26 ft.	30 ft.
Bottom width of canal...............	50 to 75 ft.	80 to 120 ft.

and further be it noticed that of the 62 miles of canal in excavation, as proposed in 1872, but about four miles coincide in location with the present line.

The present is almost entirely a new project, and the estimates are made in the light of experience gained in 20 years, and through the expenditures for new surveys of nearly half a million dollars, and in construction of several millions more.

(2.) The importance of the question of rainfall has always been recognized by the company's engineers and it has given wide publicity to the facts. Previous to 1885 practically nothing was known concerning the rainfall on the Atlantic slope, except that it was of great volume. The company has kept records which are entirely complete since 1890. They show the total annual rainfall in Greytown to be 296.94 in. in 1890, 214.27 in. in 1891 and 291.15 in. in 1892. The maximum daily rainfall recorded is a little over 6 in. in 24 hours. The amount of precipitation decreases rapidly from the Atlantic coast to the highlands of the interior. Records kept in 1890 at Greytown and at the foot of the eastern divide, about 10 miles inland, show a decrease of 34 per cent. in this region as compared with Greytown. No other records except those kept by the company are in existence and if it had cared to suppress the fact that the annual rainfall is about 300 in., it could easily have been done. The detailed records showing monthly rainfall can be had by applying at the company's office and the diurnal record has been preserved at Greytown.

There is no well defined dry season on the Atlantic coast but less rainfalls from February to May than during the remainder of the year. Records kept at Riuas, west of Lake Nicaragua and five miles from the canal line, from 1880 to 1889, by Dr. Flint, who has never been in any way connected with the Canal company, show a maximum annual rainfall of 87.21 in. in 1886, and a minimum of 34.54 in. in 1885. Practically no rain falls there in the six months from November to May, and but little on the table lands of the interior, east of Lake Nicaragua.

The statement that the large rainfall has not received due consideration in the preparation of estimates and plans of the works is not sustained by the facts. That this great precipitation will have a dilatory influence and cause an increase of cost of construction over similar work in drier countries has been recognized in preparing the plans, reports and estimates, but that it will operate to the extent of being a serious obstacle in construction and maintenance or greatly increase the cost is not proved by the experience already gained in Nicaragua or in other countries similarly situated. That the surplus waters can be safely disposed of cannot, in my opinion, be disputed.

(3) A very large proportion of the work will be performed by machinery which is independent of temperature or humidity. Most of the excavation in earth, rock drilling, lifting and hauling will be done by steam and compressed air, which is as effective there as elsewhere. The efficiency of Americans directing and controlling such machinery is as great in Nicaragua as in the United States. It has been found that a dollar will produce as much result in labor in one place as the other. While a Jamaica negro will only perform little more than one-half as much work as the best laborer in the States, his wages and cost of subsistence are also but one-half that of the white man.

(4) There are no "volcanic ashes and lapalli which lie unconsolidated just where they were thrown out and showered down from the active volcanoes" anywhere in the watershed of the region traversed by the canal except in the case of the San Carlos Valley, which will be discussed later. The rock to be met with is all dacite, andesite or basalt. It is all *true rock* of varying degrees of hardness. The earth is very compact clay covered with a thin alluvium or vegetable soil. The dredging through the sea level sections is in sand which was deposited by the sea in ages past and is now covered by alluvium and vegetation. Over a mile has been dredged through this sand to a depth of 17 ft. without encountering any obstacle whatever.

(5) With the exception, perhaps, of the Ochoa Dam, the treatment of every physical condition has been conservative and in accordance with the best modern practice. The system of large areas of basin to equalize the flow and dissipate the force of the streams is the safest method of dealing with the drainage problem. The overflow weirs will be built in the solid ridge, and no water will be allowed to flow over any embankments.

(6) I will not attempt to correct the errors in the statement of the number and location of the embankments due evidently to imperfect knowledge of the topography, but will confine myself to the more important questions bearing on their construction and preservation. It is stated that "the total length of these embankments or dams (they are all dams) cannot be less than eight or nine miles running from 20 to 70 ft. in height, with probably three miles of spillways." The fact is that of the embankments, a number of them comprising a mile of crest length will be built wholly above the proposed water level with heights varying from one to eight feet. The top of the embankments will be eight feet above the water level in the basins. Another group, with two and one-half miles of crest, will rest from 1 to 20 ft. below water level. The balance will have to sustain a water pressure from 20 to 60 ft. with the exception of one in the Deseado Valley, which will have a maximum height of 70 ft., with a water pressure of 45 ft.

The statement that there is no suitable material for building the embankments or for masonry will be news to all those familiar with the actual conditions. A stiff, impervious clay, the best material possible for embankments, is found at all their sites and in all the canal cuts, except where rock is met with. Excellent rock for concrete, of which all the locks and weirs will be built, is found in the Eastern and Western divide cuts.

If precedents are needed of similar works, but of greater magnitude, they can be found in India and Ceylon, where the meteorological conditions are similar to those of Nicaragua, the annual rainfall in those countries varying from 100 to 500 in. per annum. The embankment of the Ashti Reservoir is 58 ft. high and 12,709 ft. long; the Tansa Reservoir dam, 8,500 ft. long and 118 ft. high. In Ceylon there are old tanks with embankments from 3 to 12 miles long and from 50 to 75 ft. high. By the side of these works the embankments in Nicaragua fall in insignificance.

(7) If there is something radically wrong in the plans for constructing the Ochoa Dam I would have been pleased if something more specific had been advanced. I claim that the most dangerous stage of the work will be during the period of construction when the whole volume of the river will be running over the mound, and that when the latter is carried up to its full height, the weirs discharging their proportion of the overflow, the river will be under perfect control and powerless to do harm. If we assume a maximum flood volume in the river of 75,000 cu. ft. per second passing over the unfinished work, the water will flow with a depth of seven to eight feet and a speed of about nine feet per second or six miles an hour. Comparing this with the ponderous force with which waves 25 or 30 ft. high strike against the sea slope of a *pierre perdue* breakwater, such as Table Bay or Holyhead, rolling up the incline in the shape of enormous breakers and descending with frightful speed, what will take place at Ochoa is mere child's play, and yet those breakwaters are built up in opposition to those ponderous forces by the process of dumping stones of all sizes from 50 lbs. to two or three tons until the structure projects enough above the sea to prevent the waves breaking over them. The inclination assumed by the sea face under those conditions is, generally, 6 to 1, and on the lee side, 2 to 1. We feel confident that with proper care in the selection and distribution of the material, the stones will not drift far from where they are needed, and that the downstream slope of the dam will not exceed 6 to 1. Of course it is expected the cross-section of the dam will "appear very formidable." It is a question of utilizing a large quantity of cheap material cheaply handled, instead of some other more expensive method.

(8) The Great Divide cut is no doubt a work of considerable magnitude, but there is no serious difficulty involved beyond proportional labor and expense. Experienced and responsible American contractors who have made a careful personal examination of it are ready to undertake its completion within the estimated time and, I believe, cost. Mr. Jackson, the contractor on the Manchester Canal, has been removing continuously for several months, on a section 2¼ miles long, 20,000 tons of rock per day. This is done with one shift of nine hours, and includes blasting, loading in cars, hauling and dumping. The plant consists of 59 locomotives, about 1,400 cars and 45 miles of track. He has been much restricted and embarrassed in his operations by limited dumping grounds, which would not be the case in Nicaragua. At this rate the Nicaragua cut can be completed in four years.

There is no need to discuss the suggestion that the material may prove to be similar to the Culebra cut at Panama. Diamond drill borings at intervals of 10,000 ft. have been made throughout its whole length to the bottom of the proposed excavation, and nothing "suspicious" has been revealed. There is no loose rock, sand or volcanic ashes in it, stiff clay overlaying solid rock being the only material met with. There is no need to "assume" anything. We know what there is in the Nicaragua Divide.

(9.) You fear that the San Carlos will eventually fill the canal with silt. You are evidently unfamiliar with the plans proposed or you would know that the Ochoa Dam will convert the lower part of the valley into a basin 20 miles long and from one to two miles wide in its lower part and 60 ft. deep; a waste weir will be built 1,200 ft. long in the confining ridge on the east side of the valley, five miles south of the Ochoa Dam over which the San Carlos will discharge instead of seeking the further outlet at the dam; the heavy material carried along by the rapid current in the river will be dropped at the head of the basin as the current slackens and the lighter material held in suspension will follow the slowly moving current which sets toward the weir over which it will be carried and reach the San Juan below Ochoa. If, in the course of centuries, this basin should become filled with sand, the evil can be radically disposed of by diverting the whole volume of the San Carlos to the eastward and into the San Juan below the dam.

No provision need be made to prevent the silting of the excavated 14-mile channel on the east side of Lake Nicaragua, for the water is always smooth there; this being the side whence comes the prevailing "trade" winds there is no appreciable current, and the mud is stiff enough to stand at the slope proposed.

10. It is unfortunate that you did not give to the world the reasons for the conclusion that "the question of practicability and cost of the restoration of the ruined harbor at Greytown and the cost of building one at the present roadstead at Brito are important and full of difficulty" when so much valuable space is devoted to other much less important matters. The favorable results accomplished at Greytown by the building of but a small section of the breakwater have exceeded all expectations. Ships drawing 12 ft. get into the harbor through a channel where a short time before a sand bank 6 ft. high projected above the waters and encircled the whole bay.

(11.) Much space is devoted to the theoretical discussion of the well known resistance and retardation encountered by vessels navigating restricted channels with special reference to the rock-cut cross section of the Nicaragua Canal and comparing it with the enlarged section of the Suez Canal. To investigate the subject more fully than is shown in the comparative sections published I will give a table showing the dimensions of the principal ship canals, either in actual operation, under construction, or projected :

TABLE SHOWING DIMENSIONS OF PRINCIPAL SHIP CANALS OF THE WORLD.

Canals.	Depth in feet.	Surface width.	Bottom width.	Area of prism.	Length in miles.	
Suez, original dimensions, earth	26.2	328	72.2	4,170	100	Existing.
Suez, enlarged dimensions, earth	27.9	328	112.9	5,412		Enlarging.
Nicaragua rock section......	30.0	80	80	2,400	7.8	Proposed.
Nicaragua earth section.........	30.0	184	80	3,960	9.7	
Nicaragua earth section	28.0	288	120	5,212	9.3	
Manchester earth section.........	26	172	120	3,796	35	Nearly completed.
Manchester rock section.........	26	130	120	3,250		
Amsterdam earth section.........	23	186	88.5	3,156	15.5	Existing.
Corinth rock section............	28	77.4	72.2	1,945	4	Nearly completed.
Panama earth section	27.8	160	72.2	3,227	47	Proposed.
Panama rock section............	29.5	91.8	78.7	2,513		
North Sea and Baltic earth....	28	197	85	3,930	60	Constructing.
Bruges..........	26.25	223	65.5	3,789	6.5	Proposed.

N. B.—The dimensions given are taken at mean low water.

Taking the dimensions given in the table it will be observed that Nicaragua Canal prisms compare favorably with those of other canals in successful operation or under construction, except the enlarged prism for the Suez Canal. The conditions at Suez cannot be compared to those in Nicaragua. There nearly the whole canal is in excavation and the enlargement is done to enable vessels to meet at any point instead of at certain turn-out places only, which causes much loss of time and frequent grounding in getting into and out of the turnouts. The large section is caused by the flat slopes and wide beams made necessary in the loose sand through which the canal passes and the difficulty of getting suitable material for protecting the slopes.

In 1885 an "International Commission" proposed a scheme for the enlargement of the Suez Canal. It contemplated the deepening and widening to be done in successive stages to be extended over many years, the capacity to keep pace with the growing demands of traffic. In 1886 the work of deepening was begun, and in 1889 the depth had been increased throughout to 8.50 millimetres (27.9 ft.). The widening was then begun and is still in progress. It is carried on only on one side of the prism, the increase in width being 15 millimetres (49.2 ft.). In 1890 the widening had been completed to kilometre 24; and in 1891 to kilometre 34, and from kilometre 152 to Suez, a distance of eight kilometres; in 1892 from kilometre 34 to kilometre 41 (see annual reports of Suez Canal Co.). In other words up to the present time about 50 kilometres, or 31 miles, of the total of 100 miles has been widened 15 metres on one side only. In 1890 3,389 vessels of 9,749,129 tons passed through the canal, through what was then, and is practically yet, the original prism. It is doubtful whether the widening will ever be done on the other side of the canal, except, perhaps, in some of the sharper curves, and if pushed at the present rate the whole cannot be finished for a score of years.

The proof that the engineers did not attach much importance to the retardation due to ships moving at slow speed through a restricted channel is found in the fact that after long experience at Suez they designed the Corinth and Panama canals with smaller prisms than those proposed in Nicaragua. Instead of a restricted channel throughout its whole length, in the Nicaragua canal the rock section is divided into two and the earth into many short lengths, separated by broad and deep basins through which the largest vessels can steam and meet others without slacking speed.

(12.) It is quite likely that the Canal company has never discussed the practicability of towing sailing vessels through the canal for the simple reason that no one has ever disputed it. The exact rate to be charged for towing can be easily fixed, though I am unaware of the proposed course of the company in this regard. The following data compiled from various resources would indicate that the expense under this head will not be onerous.

On the Hudson River loaded barges in fleets are towed from New York to Albany, a distance of 144 miles, at the rate of about .07 cent per ton per mile, and empty at the rate of $20 per barge. In New York Harbor from piers to outside Sandy Hook Bar, a distance of about 23 miles, about $50 is charged on a vessel of 1,000 tons, and about $75 on one of 2,000 tons, or at the average rate of .18 cent per ton per mile. From Philadelphia to Delaware Breakwater, a distance of 103 miles, on vessels of 2,000 tons and upward $258 is charged, or at the rate of .125 cent per ton per mile. On the Columbia River, from Portland to Astoria, or to the sea, a distance of about 100 miles, the towage is at the rate of .1⅝ cents per ton per mile.

Leaving out the Hudson River rate, which applies to conditions that will not exist in the Inter-oceanic Canal, we find that the average rate for the places mentioned is about .157 cent per mile, or about 27 cents per ton the whole length of transit of 170 miles at Nicaragua. If the canal rates are placed at $2.50 per ton, the towing cost would be slightly above one-tenth of that sum.

These rates, of course, include the profits of the business. In Nicaragua coal would cost somewhat more than in the states, but there would not be the loss of time and additional expense occasioned by ice and storms which prevail to a greater or less extent in the northern localities during the winter months.

To induce sailing vessels to use the Nicaragua route, the company could well afford to make some concessions in the matter of towage rates. If found necessary they would be taken through at a rate no greater than the actual cost. With tugs proportioned somewhat to the size of the ship to be towed, they could make the transit through the canal in about the same time that the ordinary tramp freight steamer required.

In conclusion I would say that the experience and information gained in the work already done in dredging to a depth of 17 ft. over a mile of canal through the swamp back of Greytown; in building 12 miles of standard gauge railroad through these so-called impassable swamps; in the construction of a part of the breakwater at the harbor entrance; in clearing a large part of the canal route and in other preparatory works, all of which have been done inside of the estimates and without meeting greater obstacles than had been anticipated, convinces me, and, I believe, should convince any other unprejudiced critic that the whole work can be executed within the estimated time and cost.

A. G. MENOÇAL, *M. Am. Soc. C. E.*

TECHNICAL.

Manufacturing and Business.

The Safety Car Heating & Lighting Company finds it necessary to increase the office facilities of the Chicago branch. With this end in view it has removed from 1020-1022 "The Rookery" to larger offices at 1017 Monadnock Building, Jackson and Dearborn streets, where the Western manager, Mr. Merle Middleton, will give his personal attention to the business.

Mining Engineer A. Leofred, of Quebec, thinks 1893 will be active in mining, from the number of mineral assays and the numerous orders for reports on mines sent to him.

With the assent of the holders of 99 per cent. of the stock and bonds of the Electric Secret Service Co. all of the property, patents and good will of that company were sold by C. P. MacKie, Receiver, on Feb. 11, 1893, to the Electric Selector & Signal Co. This new corporation has acquired other important inventions relating to the general subject of electrical selection, and proposes to develop this business as applied to telegraphs, block signals, electric light and power and telephones, in this country and abroad, on a larger scale than the company which it succeeds. The change has been effected without interruption of the business of the Electric Secret Service Co., and upon terms which provide for a settlement of all of that company's obligations in full in cash. The Electric Selector & Signal Co. will have the same technical management as the Electric Secret Service Co., although its board of directors will contain several new and influential names.

The Egan Co., of Cincinnati, has been awarded the "Medal of Superiority" by the American Institute of New York City for its triple drum sander for the polishing and sandpapering of all kinds of woods.

The Pittsburgh Reduction Co., of Pittsburgh, manufacturer of aluminum, whose works are located at Kensington, Pa., will make extensive improvements and additions to its plant, largely increasing the capacity for the manufacture of aluminum. It is said that upward of $150,000 will be expended for this purpose.

The Detroit Foundry Equipment Co., of Detroit, Mich., has purchased 15 acres of land at the junction of the Wabash and Calumet Terminal roads in the town of Worth, a suburb of Chicago, Ill., and will commence the erection of two buildings, 90 × 175 ft., of stone and br

The following companies have been incorporated in Illinois: Bracey Improved Spike Co., of Chicago, with a capital stock of $100,000. The incorporators are M. J. Frost, B. M. Taussig and W. N. Williams. Althouse Automatic Car Coupler Co., of Chicago, with Harry Vincent, William Bannermann and John C. Amendt as incorporators. The capital stock is $3,000,000.

The Michigan Peninsular Car Co. has declared a quarterly dividend of two per cent. on the preferred stock, payable March 1, and five per cent. on the common stock, payable April 1.

Iron and Steel.

At a meeting of the directors of the Cumberland Steel & Iron Shafting Co., at Cumberland, Md., the purchase of a site for the plant was ratified. Arrangements were also made for the construction of the plant, and the work will begin as soon as contracts can be made.

New Stations and Shops.

The removal of the Grand Trunk Shops from Lindsay and Allandale, Ont., to Orilla, Ont., the future headquarters of the Midland & Northern lines, will, it is said, take place early in the spring.

The Wisconsin Bridge Co. is removing its works from Wauwatosa to North Milwaukee, Wis. The new plant will be entirely of iron except the foundations. Four buildings will be erected which will cover one enthe

block, or 300 × 300 feet. It is expected that the plant will be completed by May 1.

The Delaware & Hudson Canal Co. will build a car repairing shop at Oneonta, N. Y.

The Union Terminal Belt Railroad, a new Kansas City belt line, has purchased a three-acre tract of land in Armourdale, upon which machine shops and a roundhouse will be built.

The New American Transatlantic Ships.

The Cramp Shipbuilding Co. has already practically commenced work on three of the five new ships for the International Navigation Co., the old Inman line, now known as the American line. The ships will be the equal in every respect of the "Paris" and "New York," which now float the American flag. The keel blocks for the new ships have been placed in position at the Cramp yards and the shaping of the hulls will soon follow. The first of the ships, which will also be the first vessel of this class to be built in an American yard, will be launched in about twenty months. Clement A. Griscom, President of the International company, says that "the company will spare no trouble or expense to make these ships the equals, and if possible, the superiors, of any that now cross the Atlantic Ocean. There is not the least reason to doubt the ability of the contractors to duplicate the work of the best builders of Europe." The Philadelphia *Record* says that it is proposed by the Cramps to carry on the construction of all three vessels at the same time, and thus to launch them as nearly together as possible. Drawings are now being prepared for several other vessels for the same line to be built by the Cramps. The vessels for the time will be known as Nos. 278, 279 and 280. They will each be given the name of some American city when launched. The Cramp Shipbuilding Co. has placed the order for the steel plates as follows: Wellman Iron & Steel Co., two hulls and two sets boilers, 9,000 tons; Paxton Rolling Mills, two hulls, 8,000 tons; Carnegie, Phipps & Co., one hull, 4,000 tons; Carbon Steel Company, three sets boilers, 1,000 tons; Phœnix Iron Company, rolled shapes, 2,500 tons; Pottsville Iron & Steel Co., rolled shapes, 2,000 tons, a total of 26,500 tons.

The New York & New Jersey Bridge.

A bill has passed the lower house of Congress authorizing the construction of the New York & New Jersey bridge. The bill provides that the terminals on the New York side shall be subject to the approval of the Sinking Fund Commissioners of that city. It also provides that the Secretary of War shall not authorize the building of the bridge less than 150 ft. high in the clear, or less than 2,000 ft. clear span. This permits placing one pier in the river, which is in accordance with the charter from the State of New Jersey. Whether or not the bill will will get through the Senate this session is of course a matter of speculation, and if it should pass the Senate it would still have to take the chances of the War Department.

The Hudson River Tunnel.

At a meeting of the holders of the first mortgage bonds of this corporation held at the Cannon Street Hôtel, London, on Feb. 8, a report was presented which set forth that unless the tunnel could be completed it would only fetch "a giving-away price." The most careful estimates had been prepared as to the probable cost of the completion of the tunnel, and they were advised that the sum of £150,000 would be sufficient not only to complete the work, but to remedy certain defects that existed in what had already been done. This sum it was proposed to raise by an issue of stock which should take precedence of the first-mortgage bonds. The financial portion of the committee's proposition as formulated below was put and carried unanimously.

"Your committee then, having ascertained that the co-operation of the American stockholders can be secured in the creation of such a stock, and, further, that negotiations are pending in London and New York for subscriptions, conclude this report to the English bondholders with the practical recommendation that the bond be at once sent in to Messrs. Robarts, Lubbock & Co. (who have consented to receive the same), accompanied by the form for registration and indorsement, and that, in order to make some provision toward the expense of the committee and meeting some of the more pressing claims in New York pending the proposed issue, such bonds shall be accompanied by checks at the rate of 10s. for every £100 bond."

Length of Switch Rails at Haughley Junction.

At Haughley Junction on the Great Eastern (England) the six-wheeled, rigid-wheel-base tender, and the rest of a passsenger train recently left the track immediately after running through the junction switches, the train running from a branch on a curve to the main line on a tangent. The speed was probably about 42 miles an hour, and the government inspector considers that the surge of water in the tank on striking the short switch rail lifted the inner wheels completely off the rail, and then on coming down when the tender had fairly got into the straight line, the wheel flanges came down on top of the rail head and soon ran off into the six-foot way. He concludes:

"It appears from the evidence that this junction has been regarded by drivers as a "nasty" one for some time past. A divergence from the straight of 4¼ ins. in a length of 12 ft. is very severe, being equivalent to a curve of little more than 200 ft. radius (28 deg.), which even with a speed of only 20 miles an hour would theoretically require a super-elevation of the outer rail of about 6½ ins., whereas there is and can be in this instance no super-elevation at all. The standard length of switch rails in use on the Great Eastern is 12 ft., but such switches are too short for junctions of running lines, and I would recommend that the matter should receive consideration by the railroad with a view to a more satisfactory length of switch being generally adopted. In the meantime it is desirable that the speed through Haughley junction should be limited to a rate suitable to the conditions of the place, and the necessary instructions issued to this effect, as is already done in several other cases."

An English Eight-Wheel Coupled Locomotive.

A new design of locomotive has been adopted by the London & North Western (England) for handling heavy mineral traffic. The first engines of this type have just been built in the company's shops at Crewe, from designs of Mr. F. W. Webb, Chief Mechanical Engineer.

The boiler is of the same type as that of the eight-wheeled compound passenger engine "Greater Britain," which that road will exhibit at Chicago.

The tubes are divided into two lengths by a combustion chamber, those extending from the firebox to the combustion chamber being 4 ft. 10 in. long, and those of the front group 8 ft. 1 in. long.

The following gives some further particulars of the boiler:

	Ft.	In.
Length of barrel	15	6
" firebox casing	6	10
Diameter of barrel (mean)	4	3
Number of tubes	156	
Diameter of tubes	0	2⅛
Pressure of steam	160 lbs. per sq. in.	
Heating surface:	Sq. Ft.	
Firebox	114.7	
Combustion chamber	30.1	
Tubes (front)	683.	
" (back)	408.5	
Total	1,245.3	

The cylinders, which are inside the frames, are 19-in. diam. and 24-in. stroke. The valves are placed on top of the cylinders, and are worked by the Joy valve gear.

The engine is eight-coupled with no truck, the rigid wheel base being 17 ft. 3 in., such a length being almost unprecedented even in England. The driving wheels have 3-in. tires, and are 4 ft. 5½ in. diam. The distance between wheel centres is 5 ft. 9 in. The leading and trailing wheels have ¼-in. side play, to give greater facility for passing curves.

The coupling rods have solid ends bushed with oil cups forged on. The rods are duplicates of each other, and are therefore interchangeable all around. The springs on the first three pairs of wheels are connected by equalizers. The back drivers have an independent cross spring. The crank shaft bearings are 9 in. long, and there is a central frame with a 5½-in. bearing on this axle, intended to take up the bending strains due to the coupling and connecting rods. This gives a total of 23½ in. length of bearing to the main axle.

The total weight of the engine in working order is 104,916 lbs., of which 28,448 lbs. rest on the main driving wheels, and the balance is distributed equally between the front and back wheels. The weight of the tender in working order is 56,000 lbs.

The tractive force when pulling up a long grade, allowing the effective pressure on the piston to be 70 per cent. of the boiler pressure, is 18,144 lbs., giving a coefficient of adhesion of 5.78. The engine should therefore be fully capable of hauling a load of 568 net or 505 gross tons behind the tender up a long 1 per cent. grade. This amount compares fovorably with the loads hauled by the ordinary type of English freight engines.

Electricity on the New York Canals.

Mr. Sherman Petrie, of Brooklyn, has taken up Governor Flower's suggestion of electric traction on the Erie Canal by the trolley system, and has induced Assemblyman Jacob Stier to introduce a bill giving Petrie permission to make experiments at his own expense on the State property along and over the canal under the supervision of the State Superintendent of Public Works.

Compound Locomotives.

The committee on compound locomotives of the Master Mechanics' Association has sent out a circular asking information "of a practical character" on experience with compound locomotives in actual service. The committee wishes to get up a report that will "shed some light on the probable net value of compounding locomotives." A schedule of fifteen questions has been prepared asking for a great many particulars including actual descriptions of locomotives in use, with details of performance such as engine mileage, car mileage, weight of trains and consumption of coal, oil and water. Particulars of cost of repairs are also asked for as well as other specific information. Replies should be addressed to Mr. George Gibbs, Mechanical Engineer, Chicago, Milwaukee & St. Paul, Milwaukee, Wis., not later than April 1.

Gas Motors for German Street Cars.

During the past summer experiments were made at Dresden, Germany, with a street car driven by gas motors. The car weighed about seven tons and carried six gas holders, each containing about one cubic meter of gas under a pressure of six atmospheres. The gas engines were of the Lührig type, of 4 H. P. each. The gas holders were charged at one of the terminals of the line, and their capacity was considered ample for a trip of from 30 to 40 kilometers. The speed of the cars was at the rate of about six miles an hour. The gas was to be used also for heating and lighting the car. A somewhat similar method of gas engine propulsion is to be tried on the line between Nauenburg and St. Blaise, in Switzerland. The cars on that line are each to be equipped with one double-cylinder engine of 8 H. P.

Warden Automatic Table.

Queen & Co., Incorporated, have purchased from Mr. John T. Warden, of Philadelphia, the sole right to manufacture and sell his well known automatic drawing table, which in the two years it has been on the market has come into favorable notice. It is now used in many of the largest drafting rooms in the country. This table is adjustable for use either flat or slanting from either side, and it is adjustable for height as well as for angle. The straightedge, which takes the place of the T square, always moves parallel from a very ingenious lazy tongs motion by which the strings of the Bergner board pattern are dispensed with.

The Nevens Flanger.

The Nevens flanger, a device for clearing the flangeways of rails from snow and ice, which is now pretty well known, was illustrated and described in the *Railroad Gazette* of Feb. 3, 1888. An agent of the company sends us some notes of a recent trip which he made in the northern New England States and Canada. In a run over the Central Vermont, the machine was operated for several miles by General Roadmaster Shanks. It ran about 20 miles an hour, throwing snow and ice 50 ft. from the track and leaving a clear flangeway. In places the frozen gravel ballast was cut down, and high ties were planed off as if they had gone through a planer. On the Grand Trunk its operation was seen by several of the officers, including General Superintendent Stephenson, Assistant Superintendent Redlon and General Master Car Builder McWood. A half-mile of track in the yard at St. Charles, leading to Victoria Bridge, was selected. There was a solid bed of ice even with the tops of the rails, and in the middle higher than that. The machine was run over this track by a heavy shifting engine at a good speed, and it is said that the Grand Trunk officers were very much pleased with its performance. Some of the machines have been built in the shops of the Concord & Montreal Railroad for the use of that company, and we are told that the Old Colony is negotiating for the right to use it.

The Hoppes Feedwater Purifier.

A decision has just been rendered in the case of Stilwell & Bierce v. S. N. Brown & Co., the latter being the makers of the Hoppes Feedwater Purifier. The U. S. Circuit Court of Appeal for the sixth circuit found that the Hoppes device did not infringe the Stilwell patent. The court held that "the Day patent was invalid, and that the Stilwell covered only the connection of the escape pipe with the boiler, and that the Stilwell patent did not infringe that arrangement by connecting the escape pipe with the steam pipe. . . . . The complainant endeavored to have their claims broadly construed, but as the patentee has expressly limited himself to a connection with the boiler, he has given to the defendant and to the world, so far as he is concerned, the right to make the connection at any point outside the boiler and the steam dome without infringing his patent. . . , The courts have no right to enlarge a patent beyond the scope of its claim as allowed by the Patent Office, or the appellate tribunal to which contested applications are referred. When the terms of a claim in a patent are clear and distinct (as they always should be) the patentee in a suit brought upon the patent is bound by it. He can claim nothing beond it. But the defendant may at all times, under proper pleadings, resort to prior use and the general history of the art to assail the validity of the patent or to restrain its construction. The plaintiff can then resort to the same kind of evidence in rebuttal; but he can never go beyond his claim. As patents are procured *ex parte* the public is not bound by them, but the patentees are. And the latter cannot show their invention is broader than the terms of their claim; or, if broader, they must be held to have surrendered the surplus to the public.

"But it is said this is a pioneer patent; one which constitutes a decided step in the art, and that as such the courts should be liberal in construing it to cover what the patentee really invented. In our opinion all the patentee really invented was the gas escape pipe connection with the boiler. There is nothing to show in his specifications or in the evidence that he had in mind, as feasible, the connection which was made in the Day or the Hoppes patent with the steam pump. And even if there were, the words of the patentee used in his claim are too plain to admit of construction. He set limits to his monopoly in language, the effect of which no liberality in construction can avoid. "We must therefore dismiss the bill."

THE SCRAP HEAP.

Notes.

The train dispatchers of the Wyoming division of the Union Pacific have been ordered to run a few weeks each on trains in order to familiarize themselves with the characteristics of the road.

It was reported last week that the enginemen and conductors of the Savannah, Americus & Montgomery partially suspended traffic on the road by striking, but it was said on Monday that the strike was settled.

It is announced from Alton, Ill., that the Chicago, Burlington & Quincy will put on transfer boats at that point to carry freight between its Illinois and Missouri lines, pending the completion of the proposed bridge across the Mississippi.

A strike of yard trainmen on the Cleveland, Cincinnati, Chicago & St. Louis, at Springfield, O., last week seems to have proved very troublesome for a small strike. On Sunday last the company put 25 new men at work, but had to protect them by a large force of police,

A pneumatic transit line has been put in between the post office at Philadelphia and the branch post office at 123 Chestnut street. It has been put in on trial by the Electric Pneumatic Transit Company. The line is about 3,000 ft. long and there are two tubes each 6 in. in diameter.

The Baltimore & Ohio has taken a party of its traffic men from Baltimore to Chicago, to make them acquainted with the situation at the World's Fair grounds; this is following the example of the Erie, which took to Chicago companies of ticket sellers from New York City and vicinity and also from Central Ohio.

It is reported from Louisville, Ky., that 30 telegraph operators of the Pennsylvania lines in and near Louisville were recently notified that they must withdraw from the Order of Railway Telegraphers or lose their chances of promotion. The report states that nearly all of the men agreed to leave the Brotherhood.

The Union Pacific has adopted a "train telegram" envelope to be used for telegrams written during the latter part of the day, which, if sent by wire, would not be delivered in time to receive attention until the following morning. The new form is to be used for a class of important correspondence requiring quick delivery and prompt action, but for which the train mail will serve the purpose. The envelope is red in color, so that parties handling it may know that it contains important matter.

On Feb. 11 the large freight yard of the Pennsylvania road at Wall, east of Pittsburgh, was entirely cleared, for the first time in its history. This is one of the largest freight yards in the country. The east-bound business had been suddenly withdrawn by the destruction of a bridge on the Pittsburgh, Cincinnati, Chicago & St. Louis, and just as the east side of the yard was cleared by this cause a derailment on the Pennsylvania held back west-bound freight until all the cars in the yard on that side had been sent forward.

Judge Goff, of the United States Circuit Court, at Charleston, S. C., has decided the railroad tax cases. He enjoined the Sheriff of Aiken County from further interfering with the property held by the Receiver of the South Carolina Railroad Company, and ordered that all the property distrained by the Sheriff be restored to the custody of the Receiver. A similar injunction was issued in all the Richmond & Danville cases. The Court adjudged the sheriffs of Aiken, Anderson and Newberry counties in contempt, and ordered them to pay fines of $500 each. The Governor of the state is still defiant.

World's Fair Notes.

At the Schenectady Locomotive Works there is being built a miniature locomotive, like the Empire State express engine (engines 870, 903 and their like), for exhibition at the World's Fair. The scale on which it is being constructed is 1½ in. to the foot.

Chief Ives, of the Art Department, has notified Herr Wermuth, the German Commissioner, that the relics to be sent to the Fair by Emperor William will be brought over in a United States man-of-war.

Lieut. A. C. Baker, United States Navy, of the Marine Division of the Transportation Department, has received from the New York Commissioners a plan of their displays of state waterways. They will send a relief map of the canal system of the state on a horizontal scale of 2 in. to the mile. It will cover a space of 50 by 15 ft. They will also show a model of a lengthened lock on the Erie Canal, covering a floor space of 10 by 3½ ft. There will also be a model of the original lock built at Little Falls, N. Y., in 1795, and a wall map showing the water route from Duluth to New York. Besides the maps will be sent photographs of steamers in tow on the Erie Canal and the Hudson River, and of the aqueducts of the Erie Canal over the Mohawk and Genesee rivers.

Mr. Sargent, the electrical engineer, has completed his scheme for lighting the main basin on fête nights during the fair. Thousands of incandescent lights of different colors are to be used. One row will extend just above the water's edge all around the basin, and another row will be reflected into the water from a few feet higher up. Still higher on the loggias of all the buildings that surround the basin will be other rows of lights with here and there a handsome design. Rows of lights will also reach around the colonnade story of the Administration Building, which stands at the head of the basin, while the lower part of the building will be kept dark. At the base of each tier of the MacMonnies fountain will be another row of lights, over which the water will fall from the basin above. There are also to be various search lights to help out the effect. One of these will be placed in the mezzanine floor of the Administration Building to play on the MacMonnies fountain. Another on the Electricity Building will throw its light on the statue of the republic at the east end of the basin, and others will be used at other points. The effect of all these many hued lights reflecting in the water will doubtless be dazzling and beautiful.

The Rail Market.

Eastern rail mills record sales aggregating not less than 75,000 tons, and it is known that the two great Western mills have taken a number of important orders lately, the details of which are being withheld. On the whole it may be stated, however, that relatively the Eastern works have done better, having booked about 225,000 tons out of an estimated total of 375,000 to 400,000 tons, the Colorado mill being put down at 40,000 tons. Nearly all of this tonnage is for renewals.—*Iron Age.*

The following orders for rails are noted by the *Bulletin* of the Iron & Steel Association: The Carnegie Steel Co., 15,000 tons to the Wabash and 5,000 to the New York, Lake Erie & Western; the Cambria Iron Co., 12,000 tons to the Louisville & Nashville; the Lackawanna Iron & Steel Co., 15,000 tons to the New York Central, and the Pennsylvania Steel Co., 10,000 tons to the new Bangor & Aroostook road in Maine. The same company has also just sold 3,300 tons of standard rails to a Cuban railroad to be delivered at Havana. Other orders for standard rails will soon be placed. The New York Central will need 25,000 tons in addition to the 15,000 tons above noted. Orders are also multiplying for street rails for extensions and the changes in their construction and operation, particularly in the introduction of electricity, and a large tonnage for the present year is already certain. The Philadelphia Traction Co. alone has recently contracted for girder rails for 55 miles, aggregating about 8,000 tons, to be furnished by two companies in Eastern Pennsylvania.

Rogers Locomotive Company.

Jacob S. Rogers, President of the Rogers Locomotive & Machine Works, has retired from the concern and a reorganization under the name of the Rogers Locomotive Co., has been effected. Robert S. Hughes, formerly Treasurer, has been elected President. The certificate of incorporation of the new company was recorded at Paterson, N. J., this week. The capital stock is $3,000,000, of which $2,752,000 has been paid in. The stockholders are R. S. Hughes, Reuben Wells, George E. Hannal, of Brooklyn, George A. Longbottom and John W. Griggs. George A. Longbottom is the new Secretary and George E. Hannah the Treasurer. Mr. Rogers, though retiring from the active business management, still retains a financial interest in the company. He has been at the head of the firm for 37 years. Mr. Hughes has been connected with the Rogers Locomotive Works for 47 years and has been Treasurer a long time.

Street Railroads.

Ralston & Henry, of Philadelphia, contractors for electrical supplies and equipments, have recently placed the contracts for the entire material and equipment for the Richmond County belt line of Augusta, Ga., of which Mr. Malone Wheless, of Washington, D. C., is President. The road will be built with Pennsylvania's Steel Co.'s 48 lb. T-rails and equipped with Lamokin cars, mounted on Robinson Machine Co.'s all steel trucks. The wire will be furnished by the Roebling's Sons Co., of Trenton.

Moving a Heavy Traffic on the Pittsburgh, Fort Wayne & Chicago.

When the Panhandle's Newcomerstown bridge went down in the turbid Tuscarawas flood, the tide of Panhandle freight and passenger trains was at once turned over the Fort Wayne. [This traffic went over the Fort Wayne between Crestline and Pittsburgh, 189 miles. There is about 117 miles of double track on this division.] It was absolutely necessary to move a great portion of it, as much was perishable. The Fort Wayne had to bear a double burden, though it was just recovering from the Herculean task of opening its line to Chicago. The result was that in practically five days' time 1,500 Panhandle freight cars, 900 eastbound and 600 westbound, were safely run over the Fort Wayne tracks, and allowing 20 loads to a train that would make 75 trains, or an average of 15 extra trains a day. In addition there were five Panhandle through passenger trains run each way every day, so that the number of extra trains handled daily amounted to not less than 25, and perhaps more. All this was in addition to a very heavy movement of Fort Wayne trains. It was one of the most extraordinary achievements in the history of the Fort Wayne, and has but few parallels anywhere.

The train dispatchers on this division were all recently concentrated at Allegheny; when the emergency rose Chief Dispatcher Lang increased the tricks by one, making four of six hours each. Each dispatcher and operator was requested to do his best, and they all proved equal to the occasion. For the past six days the instruments have been clicking at a Nancy Hanks gait, and every dispatcher and his copying operator have been taxed to their full capacity. Dispatcher Jack Fitzgerald, during one six-hour trick, ran 33 trains from Stark to Crestline (90 miles), an achievement not to be sneezed at. But this, perhaps, was eclipsed by the handling of No. 6, the fast express due here in the afternoon. On Tuesday one of the dispatchers, a veteran, ran it around 23 freights, nearly every one westbound, and brought it in on time. They were all met and passed between Stark and Homewood (65 miles). On one day there were 13 sections of train No. 75, and at another time there were 19 freights running almost in sight of each other.—*Pittsburgh Post*, Feb. 17.

The Kanawha River Improvement.

Bids for the construction of lock and dam No. 9, of the Kanawha (W. Va.) improvement, were opened at the Resident Engineer's office at Charleston, W. Va., on Feb. 17. The bids were as follows: Humphrey Devraux, Shawneetown, Ill., $287,712; Zinnerman, Truax & Sheridan, Duluth, Minn., $283,344; Carkin, Stickney & Man, East Saginaw, Mich., $323,385; Harold & McDonald, Pittsburgh, Pa., $322,560; Thomas Munford, Lock Seven, W. Va., $293,950; Joseph Gianini, Allegheny City, Pa., $329,272. The contract will not be awarded until March 2, when the bids for all the new work on this river for the year will have been received.

Canadian Railroads.

The Minister of Railways and Canals of Canada has just presented his annual report to Parliament, showing the result of last year's operations of railroads in Canada. The number of railroads, including the Government roads, in actual operation (counting as one all amalgamated lines) was 76. The number of miles of railroad completed was 14,633 (besides 1,665 miles of sidings), of which 13,869 were laid with steel rails. There were 14,009 miles of road in actual operation. The paid-up capital amounted to $816,622,758; the gross earnings to $48,192,099; working expenses to $34,960,448, and net earnings to $13,231,649. The number of passengers carried was 13,222,568, and 21,753,290 tons of freight. The train mileage was 43,399,178. The following list shows the total amount charged to capital account, expended by the Government for construction of railroad lines, embracing the period prior to confederation, and extending to June 30, 1892: Intercolonial, $47,156,132; Eastern Extension, $1,324,042; Oxford & New Glasgow, $1,825,192; Montreal & European Short Line, $333,924; Cape Breton, $3,641,131; Carleton Branch, $88,410; Prince Edward Island, $3,75?,565; Canadian Pacific, works built by the Government and transferred to the Canadian Pacific, $30,404,577; Canadian Pacific—other expenditures on surveys, explorations, telegraph lines, Dawson Route, Fort Frances Lock, etc., $6,639,581; and the Annapolis & Digby, $614,789. Subsidies to railways: Canadian Pacific, $25,000,000; Canadian Pacific extension to Quebec, $1,500,000; Canada Central, $1,525,250; other railroads, $9,695,108. Total, $133,498,708. This amount does not include the annual subsidy of $186,600, payable for 20 years to the Atlantic & Northwest, nor the annual payment of $119,700 to the Provincial Government of Quebec, being five per cent. on the sum of $2,394,000 granted for the line between Ottawa and Quebec. Since the system of subsidy of railroad enterprises by the Dominion was commenced the total payments have been 9,957,665, of which $1,061,615 was paid in the year to June 30, 1892, and $262,561 between June 30 and Dec. 31, 1892.

Referring to the Chignecto Ship Railway, the Minister of Railways says that by the act (1892) authority was given to the company to issue new mortgage bonds to the value of £350,000 sterling, and by an order in Council passed July 9, 1892, a recommendation to Parliament to extend the time, further, July 6, 1894, has been promised.

Electric Railroads.

A charter for the Wellsburg & Leazearville Company has been applied for in West Virginia, and will be issued this week. The company proposes to build an electric line from Wellsburg to Leazearville and Bethany, W. Va. The incorporators are H. C. Ulrich and T. W. Carmichael, of Leazearville; H. G. Leazear, G. W. McCleary, and others, of Wellsburg, W. Va. The proposed route is from a point opposite Steubenville to Wellsburg, thence to Leazearville and to Bethany and Windsor, all in Brooke County, W. Va. The company proposes to haul passengers and light freight and express packages between the three towns. The capital stock subscribed is $100,000.

LOCOMOTIVE BUILDING.

The Evansville & Terre Haute is in the market for five engines.

The Wilkes-Barre & Eastern is asking bids for five consolidation, five ten-wheel freight and five eight-wheel passenger locomotives.

The Pittsburgh Locomotive Works has received a contract from the Pittsburgh, Shenango & Lake Erie for building eight ten-wheel freight engines.

CAR BUILDING.

The Wilkes-Barre & Eastern is asking bids for 1,000 hopper bottom gondola cars.

The Baltimore & Ohio Railroad will shortly place an order for 2,200 freight and 200 excursion cars.

The Wisconsin Central Line has just completed 50 gondola cars of 50,000-lbs. capacity, also ten 42-ft. furniture cars.

The Chicago & Northern Pacific Railroad Company has ordered 20 standard suburban coaches from the Ohio Falls Car Manufacturing Company.

BRIDGE BUILDING.

Des Moines, Iowa.—Proposals are wanted until March 3 for the construction of a four-span iron bridge by James Carss, City Engineer.

Dorchester, N. B.—A new steel girder bridge is being built for the Intercolonial Railroad at Dorchester, by James Fleming, of St. John. The bridge is to be 84 ft. in length, and is to be finished in August.

Fitchburg, Mass.—The contract for the construction of three bridges on the new county road between South Fitchburg and North Leominster has been awarded to the Groton Bridge Co., Groton, N. Y., at $9,761.

Hokendauqua, Pa.—An overhead bridge to cost about $20,000 will be erected next summer over the Lehigh River from Hokendauqua to a point above Catasauqua, Pa. The cost will be borne by the counties of Lehigh and Northampton, and perhaps an electric line which desires to cross.

Monticello, Minn.—S. M. Hewitt & Co., of Minneapolis, have the contract for building the bridge across the Mississippi River at this place. The contractors are now at work on the piers, and will soon begin the erection of the superstructure. The total cost of the bridge will be $22,000, and of this amount the county commissioners of Wright County have appropriated $6,000.

Natchitoches, La.—Proposals are wanted until March 10 for a 480-ft. swing bridge by C. V. Porter, President of the Cain River Bridge Co.

Plymouth, Pa.—The bridge at Plymouth has been leased for a term of years by the Wilkes-Barre Traction Co., which will shortly tear it down and erect in its stead a handsome iron structure.

Revelstoke, B. C.—Work has been prosecuted vigorously, in spite of the bitter weather, by the Canadian Pacific engineers, under Chief Engineer E. J. Duchesney, who are engaged in finding the best site for the new steel railroad bridge over the Columbia River at Revelstoke. The depth to the bed rock at the old bridge was 33 ft., while at the outlet of the big eddy, where the river narrows to 600 ft., bottom was found at 43 ft. The soundings are not yet completed.

Rochester, N. Y.—The Executive Board has awarded the contract for the construction of a wrought iron bridge over the Western New York & Pennsylvania Railroad, at the Bronson avenue crossing, to the lowest bidder, the Rochester Bridge & Iron Works, for $6,516.

St. Louis.—Senator Palmer, of Illinois, has introduced in the United States Senate, and Representative Foreman in the House, bills of similar import for the erection of a bridge across the Mississippi River from a point in St. Clair County, Ill., to the city of St. Louis, Mo.

Spencer, W. Va.—The matter of building a steel highway bridge over Spring Creek to connect Spencer with East Spencer is being agitated before the County Court of Roane County, W. Va., with good prospects that the bridge will be built this summer. The width of Spring Creek is about 100 ft.

Winnipeg, Man.—The contract for the new truss bridge across the Red River at Winnipeg has been awarded to W. S. Reed, of Montreal. The bridge is to be located at Main street, and will be a Howe truss structure on stone piers. There are five spans, three of 130 ft. each and two of 100 ft. The cost will be about $60,000.

RAILROAD LAW—NOTES OF DECISIONS.

Carriers of Goods and Injuries to Property.

In South Carolina the rules of an express company required a receipt for money packages before the same were delivered. On the morning the money in question was to reach L. the train was late, and H. knew he would not have time, after the train arrived, to receipt for the money and take passage on the train, as he desired. Therefore, by promising to "relieve" the express agent from liability, he persuaded him to let him (H.) re-

ceipt for the money in advance. After the train arrived the agent carried the package to the platform of the car on which H. stood and pitched it toward him, saying, "Here is your money." The package lodged on the platform step, and it was claimed that H. never actually received it. The Supreme Court holds that on the above facts, by the arrangement between H. and the express agent, such agent ceased to be the agent of the express company and became the agent of H.; that H. assumed all risk and absolved the company from all liability thereafter.[1]

In North Carolina the Supreme Court holds that where a railroad, in repairing its road, altered its embankment on the sides of a stream running through plaintiff's land, so as to extend the embankment further into the stream, and causing it at times to pond back on plaintiff's land, plaintiff is not guilty of contributory negligence because he planted crops on the land knowing that such land was liable to be overflowed and the crops injured.[2]

In Pennsylvania the Supreme Court rules that the construction of a railroad bridge across a street, and 23 ft. above its surface, is an additional servitude, for which the company is liable to the owner of the fee, but that the fact that horses in front of plaintiff's property might be frightened by trains passing over the bridge is not such an interfence with the access to the property as to come within the provision of the constitution, which provides that corporations must make compensation for property " taken, injured or destroyed " by the construction of their works.[3]

In the same court it is held that the owner of a lot which is several hundred feet from the line of a railroad cannot recover damages for the annoyance caused by the smoke, dust and noise of passing trains. And that land distant from a street, but connected therewith by a private way over the intervening land, does not abut on the street; and the owner cannot recover for the inconvenience caused by the construction of a railroad in the street, where his way is not closed or disturbed.[4]

Injuries to Passengers, Employees and Strangers.

In Indiana the Court of Appeals holds that where a passenger, in the presence of others, has acceptance of his ticket wrongfully refused by the conductor, and is obliged to pay another fare to avoid ejection, he can recover for the feelings of humiliation and shame suffered by him.[5]

In Pennsylvania the Superior Court rules that a railroad employé who travels several times daily for a number of years over the line at a place where it is crossed by a public road, and must therefore know the danger of collisions with vehicles at the crossing because of freight cars obstructing the view, assumes the risk of collisions if he makes no complaint to the company in regard to the crossing and the necessity of keeping a watchman there.[6]

The Supreme Court of Michigan holds that a track hand who remains in the employ of a railroad company with knowledge of a rule that "No notice whatever will in any case be given of the passage of extra trains," assumes the risk of such train.[7]

The Supreme Court of California holds that, where a trainman continues in the employ of a railroad company after full knowledge that the cars were defective in construction and the train force deficient in number, he assumes the risk arising therefrom, and cannot recover in an action for personal injuries caused thereby.[8]

In Georgia a servant of a railroad company, while crossing its yards at night, going to wake up the master mechanic, fell into a pit over which engines were cleaned. He testifies he did not see it because it was dark and there was no light, and that he could not see it unless he had been watching very carefully. He carried no lamp, having been furnished none, and made no attempt to get one. Although it was his duty to make such trips at night he had made no effort to familiarize himself with the locality. The Supreme Court holds that, as he was negligent, and could have avoided the accident by ordinary care, the company was not liable.[9]

In the Federal Court, a sectionman was on a hand car under the control of a section boss, and was going at the rate of 10 miles an hour. The brake appliances on the car had been supplied by the section boss, and were defective. A rapidly moving freight train approached through a cut and around a curve, giving no warning or signals. The brake on the hand car was applied without effect, and plaintiff, believing himself in imminent peril, jumped, falling between the rails, and the hand car ran over him. The Supreme Court holds the railroad liable.[10]

In the same case it is held that the negligence of the officer in charge of a train in failing to give warning as the train rapidly approached a hand car on the track was not one of the usual and ordinary risks assumed by a section hand on the car as incident to his employment.[11]

In Georgia it is ruled by the Supreme Court that a servant of a railroad company does not assume the risk of all dangers arising from the use, with the company's permission, of a section of its main line by another company without legislative authority.[12]

In Indiana the Supreme Court rules that where an engineer runs his train within the city limits at a rate of speed forbidden by a city ordinance the company is liable thereunder, though it had instructed the engineer not to so run his train, and had no knowledge of his act.[13]

In California, in an action by a brakeman for injuries received while coupling cars, it appeared that it was dangerous to go between the cars because they had short drawheads and no bumpers, which was known to plaintiff, and that it was usual to make couplings by so placing the pin that it would fall into place when the cars came together, or by using a stick. At the time of the accident plaintiff went between the cars to be coupled, which were one foot apart, and at a point from which he could not see the engineer, and while adjusting the coupling pin the cars came together, and caught him between them. The Supreme Court decides that the injury resulted solely from plaintiff's carelessness.[14]

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1 Carroll v. Southern Exp. Co., (S. C.) 16 S. E., 128.
2 Knight v. Albemarle & R. R. R. Co., 15 S. E. Rep., 929.
3 Jones v. Erie & W. V. R. R. Co., 25 Atl. Rep., 134.
4 Pennsylvania Co. for Insurance on Lives and Granting Annuities v. Pennsylvania S. V. R. R. Co., 25 Atl. Rep., 107.
5 C. & E. I. R. R. Co. v. Conley. 32 N. E. Rep., 96.
6 Rumsey v. D., L. & W. R. R. Co., 25 Atl. Rep., 37.
7 Jolly v. Detroit, L. & N. R. R. Co., 53 N. W. Rep., 526.
8 Long v. Coronhdo R. R. Co., 31 Pac. Rep., 170.
9 Countryman v. E. T., V. & G. Ry. Co., 16 S. E. Rep., 84.
10 N. P. R. R. Co. v. Charles, 51 Fed. Rep., 562.
11 Id.
12 C. R. & B. Co. v. Passmore, 15 S. E. Rep., 760.
13 City of Hammond v. N. Y., C. & St. L. Ry. Co., 31 N. E. Rep., 817.
14 Long v. Coronado R. R. Co., 31 Pac. Rep., 170.

MEETINGS AND ANNOUNCEMENTS.

Dividends:

Dividends on the capital stocks of railroad companies have been declared as follows:

Chicago, Burlington & Quincy, quarterly, 1¼ per cent., payable March 15.

North Pennsylvania, quarterly, 2 per cent., payable Feb. 25.

Stockholders' Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Atlanta & Charlotte Air Line, annual, New York City, March 8.

Missouri Pacific, annual, New York City, March 14.

New York, Susquehanna & Western, annual, Jersey City, N. J., March 9.

Norfolk & Southern, annual, Norfolk, Va., March 2.

Northern Pacific, special, New York City, April 20.

Old Colony, special, Boston, Mass., Feb. 28, to act upon the lease of the New York, New Haven & Hartford.

Oregon Short Line & Utah Northern, annual, Salt Lake City, Utah, March 15.

Pittsburgh, Cincinnati, Chicago & St. Louis, annual, Pittsburgh, Pa., April 11.

St. Louis, Iron Mountain & Southern, annual, New York City, March 14.

Texas & Pacific, annual, New York City, March 15.

Technical Meetings.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *New England Railroad Club* meets at the United States Hotel, Boston, Mass., on the second Wednesday of each alternate month, commencing January.

The *Western Railway Club* meets at the rooms of the Central Traffic Association in the Rookery Building, Chicago, on the third Thursday in each month, at 2 p. m.

The *New York Railroad Club* meets at the rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York City, on the third Thursday in each month, at 7:30 p. m.

The *Central Railway Club* will meet at the Hotel Iroquois, Buffalo, N.Y., on the fourth Wednesday of March.

The *Northwest Railroad Club* meets at the St. Paul Union Station, on the first Saturday of each month, except during June, July and August, at 7:30 p. m.

The *Northwestern Track and Bridge Association* meets at the St. Paul Union Station on the Friday following the second Wednesday of March, June, September and December, at 2:30 p. m.

The *American Society of Civil Engineers* meets at the House of the Society, 127 East Twenty-third street, New York, on the first and third Wednesdays in each month.

The *Boston Society of Civil Engineers* meets at Wesleyan Hall, Bromfield street, Boston, on the third Wednesday in each month, at 7:30 p. m.

The *Western Society of Engineers* meets at 78 La Salle street, Chicago, on the first Wednesday in each month, at 8 p. m.

The *Engineers' Club of St. Louis* meets in the Laclede Building, corner Fourth and Olive streets, St. Louis, on the first and third Wednesdays in each month.

The *Engineers' Club of Philadelphia* meets at the House of the Club, 1122 Girard street, Philadelphia, on the first and third Saturdays of each month.

The *Engineers' Society of Western Pennsylvania* meets at its rooms in the Thaw Mansion, Fifth street, Pittsburgh, Pa., on the third Tuesday in each month, at 7:30 p. m.

The *Engineers' Club of Cincinnati* meets at the rooms of the Literary Club, No. 24 West Fourth street, Cincinnati, O., on the third Thursday in each month at 8 p. m.

The *Civil Engineers' Club of Cleveland* meets in the Case Library Building, Cleveland, O., on the second Tuesday in each month, at 8 p. m. Semi-monthly meetings are held on the fourth Tuesday of each month.

The *Engineers' Club of Kansas City* meets in Room 200, Baird Building, Kansas City, Mo., on the second Monday in each month.

The *Engineering Association of the South* meets on the second Thursday in each month, at 8 p. m. The Association headquarters are at Nos. 63 and 64 Baxter Court, Nashville, Tenn.

The Denver Society of Civil Engineers meets at 36 Jacobson Block, Denver, Col., on the second and fourth Tuesdays of each month except during July, August and December, when they are held on the second Tuesday only.

The *Civil Engineers' Society of St. Paul* meets at St. Paul, Minn., on the first Monday in each month.

The *Montana Society of Civil Engineers* meets at Helena, Mont., on the third Saturday in each month, at 7:30 p. m.

The *Civil Engineers' Association of Kansas* meets at Wichita, Kan., on the second Wednesday of each month, at 7:30 p. m.

The *American Society of Swedish Engineers* meets at the clubhouse, 250 Union street, Brooklyn, N. Y., and at 347 North Ninth street, Philadelphia, on the first Saturday of each month.

The *Engineers' Club of Minneapolis* meets in the Public Library Building, Minneapolis, Minn., on the first Thursday in each month.

The *Canadian Society of Civil Engineers* meets at its rooms, 112 Mansfield street, Montreal, P. Q., every alternate Thursday except during the months of June, July, August and September.

The *Association of Civil Engineers of Dallas* meets at 803 Commerce street, Dallas, Tex., on the first Friday of each month at 4 o'clock p. m.

The *Technical Society of the Pacific Coast* meets at its rooms in the Academy of Sciences Building, 819 Market street, San Francisco, Cal., on the first Friday in each month, at 8 p. m.

The *Tacoma Society of Civil Engineers and Architects* meets in its rooms, 201 Washington Building, Tacoma, Wash., on the third Friday in each month.

The *Association of Engineers of Virginia* meets at Roanoke on the second Saturday in each month, except the months of July and August, at 8 p. m.

American Society of Civil Engineers.

At the meeting Wednesday evening, Feb. 15, Mr. Owen's paper on "Some Controverted Questions in Road Construction" was discussed. Written discussions by Messrs. Edward Prince, J. Foster Crowell, E. W. Howe, Wm. H. Grant, Latham Anderson, Wm. C. Oastler, Peter Callanan and Edwin Mitchell were read.

Mr. H. M. Wilson spoke of the excellent roads in India, some of them 50 and 60 years old, which were made entirely without machinery, the stone being broken by hand and the rolling being done by small hand rollers. The stone used is a hydraulic limestone which is preferred by the British engineers to the trap rock, of which there is an abundance, mainly, perhaps, because of the lack of machinery for crushing, although this limestone is much superior to the limestone found in this country. Mr. Wilson attributed the excellent preservation and the excellent condition of the roads in India chiefly to the fact that they are kept in constant repair.

Mr. W. S. Bacot replied to some of the criticisms in Mr. Owen's paper as to Staten Island roads and differed with Mr. Owen as to the use of steam rollers, preferring them to the horse roller under most circumstances. The use of the steam rather than the horse roller was advocated by all who discussed this question except Mr. Oscar Saaybe, who stated that the horse roller was used in Denmark to great advantage on the road running through the country, called the "King's Highway."

Mr. North in reply to criticisms of Mr. Wm. H. Grant stated that he believed that some of the roads built by Mr. Grant were the best roads in the world; that some of the best roads in France and England which he had examined were not so well built as these roads of Mr. Grant; and that the excellence of some of the foreign roads was due not only to excellence in building but also to efficiency of maintenance.

Canadian Society of Civil Engineers.

The annual meeting for the election of the Council for 1893 and the transaction of other business at the Society's rooms, 112 Mansfield street, Montreal, was called for Feb. 23. A paper on " Transmission and Distribution of Power by Means of Compressed Air, by Prof. J. T. Nicholson, B. Sc., M. Can. Soc. C. E. was announced for the meeting at 8 p. m. On Friday, Feb. 24, the members will attend the formal opening, by Lord Stanley, of Preston, of the New Engineering and Physics Buildings, McGill University. On Friday afternoon, at 2:30 p. m., through the kindness of the Grand Trunk and Canadian Pacific Railroad authorities, there will be an excursion to visit the Victoria and Lachine bridges, and at 8 p. m. there will be a conversazione in the engineering buildings, McGill University, to which all the members are, through the courtesy of the Governors of McGill University, invited.

Engineering Association of the South.

The regular February meeting of the Association was held at the Association headquarters in Nashville, Tenn., Feb. 9, President E. C. Lewis in the chair. Mr. E. N. Pegelsen, of Pineville, Ky., was elected a member, and Mr. John Hill Eakin, of Nashville, was elected an Associate.

The paper of the evening was presented by Prof. Wm. T. Magruder, of Vanderbilt University. His subject was " Mechanics as a Fine Art." After clearly drawing the distinction between science and art he showed by example how an art, to be a fine art, must minister not to the material necessities or conveniences of man, but to his love of beauty, and that the essence of all fine arts is the imagination, and that they cannot be produced or practiced by habit and calculation. The engineer or architect who starts to design a machine or structure scientifically must of necessity call the art of applied mechanics to his assistance. Having determined its outlines by a study of the requirements of the problem, having worked, by calculation from the rules of the arts, the form, size and strength of its various parts, he has but completed the demand made upon him by a utilitarian age and the exigencies of business competition. To construct a building, erect a bridge or build a machine of such a design that, while it may be in accord with all the rules of the art, yet offends the eye and does not appeal to our sense of beauty at least by comparison, is to take a step backward in civilization, to insult the taste of men of cultivation and to lose an opportunity to expand one's own mind. His paper was a plea for the freer use of the imagination and of the beautiful in structures and machines.

Engineers' Club of Philadelphia.

At the regular meeting of the club, held on Saturday, Feb. 18, Mr. S. M. Vauclain read a paper on the Baldwin four-cylinder locomotive, illustrated by a working model and by lantern slides.

At the business meeting on Feb. 4, 1893, President John Birkinbine in the chair, 40 members and visitors were present. The proposed amendment to the by-laws increasing the annual dues of resident members to $15 was lost, not receiving a two-thirds vote.

Dr. Henry Leffmann presented the paper of the evening on " The West Sterilizer for Water and Milk," illustrating his remarks by the projecting lantern and by means of the apparatus itself.

Engineers' Club of St. Louis.

At the meeting at the club rooms in St. Louis Feb. 15 Mr. O. W. Ferguson read a paper on " Methods and Results in Precise Leveling." Mr. Ferguson described the instruments used, the methods employed and the causes of error. He cited results from different surveys, exhibited profiles, forms of note books employed, and speed of working. He gave the cost of precise leveling at $18 to $21 per mile for field expenses. Cited a polygon of 4,000 miles in length, extending from Chicago to New York, Biloxi, New Orleans, back to Chicago, that closed with an error of one foot. Stated that bench marks had been established every 1¼ miles along the Missouri River from St. Louis River to Sioux City by the Missouri River Commission. The paper was discussed by Messrs. Moore, Curtis, A. L. Johnson, Flad, Ockerson, Jolly, Colby, Blaisdel and Wheeler.

The Civil Engineers' Club of Cleveland.

The club met at its club rooms Feb. 14. The tellers reported that Edward Charles Cooke, John Ross Bitner, Samuel Groves, Willet Warren Read, Charles Frederick Uebelocker and Charles W. Foote had been elected active member, and Alvin Irwin Findley and James Wood associate members. The Committee on Nomination of Officers for the coming year, reported as follows: *President*, A. H. Porter, C. M. Barber; *Vice-President*, C. S. Howe, M. W. Kingsley; *Secretary*, F. C. Osborn, E. P. Roberts; *Treasurer*, C. P. Leland, E. H. Jones; *Librarian*, C. H. Benjamin, C. L. Saunders; *First Director*, C. W. Wason, John Walker; *Second Director*, J. N. Richardson, Jas. Ritchie.

Mr. Herman read a paper on, "A Weldless Chain." Mr. Herman said : " Oval link welded chain, as used in ship cables for hoisting, is produced in almost the same manner as it has been for several centuries past. Few and but slight improvements have been introduced in this industry. Devices intended to supplant this class of chains have never succeeded; for all sacrifice the flexibility at every joint possessed by the ordinary chain. The new chain invented by the writer consists of links each formed of four separable parts—two side-bars and two end pieces. The latter are provided with suitable threaded cavities to receive the screw ends of the former. The links so constructed possess the flexibity of the common chain to the fullest extent. Material and form of each part

are selected with regard to the work they have to perform in practical use, while the proportions at each joint are determined by the most careful calculation. In this way a link is produced that fulfils all the theoretical and practical requirements of a perfect chain, and is at the same time free entirely from the uncertainity of the weld. The different sizes of this chain will be introduced by indicative numbers. These will convey full information as to the strength, safe load and pitch of each size. The chain will be produced ready for use by means of automatic machines invented by the writer. Under the most trying tests this chain has proved its strength and reliability.

Western Railway Club.

At the regular monthly meeting of the Western Railway Club held in The Rookery, Chicago, on Feb. 21, 1893, the paper read at the January meeting by Mr. G. W. Rhodes, on "Wheel Flanges," was discussed at some length by Messrs. C. F. Street, W. H. Marshall, G. W. Rhodes, A. M. Waitt and others. In consideration of the wide variations in practice brought out by Mr. Rhodes' paper as to the relation of wheel flanges to track, the Secretary was instructed to suggest to the M. C. B. and M. M. associations, through their secretaries, the advisability of appointing a joint committee to consider the matter, and lay the result of their investigations before the American Society of Railroad Superintendents, with a view to ultimately bringing about a better understanding of this subject with the engineering department of railroads.

A paper was read by Mr. William Forsyth on "Tests of Locomotives on Heavy Express Service," and giving an account of the tests made by the C., B. & Q. Railroad during the past year with simple and compound locomotives of different designs. This paper will be discussed at the March meeting of the club.

PERSONAL.

—Mr. John R. Wheeler, who was Railroad Commissioner of Illinois in 1889, died at Chicago, Feb. 20, after a long illness.

—Mr. F. W. Holtzinger, for nearly two years Superintendent of the Perry County road, in Pennsylvania, has resigned to take another position.

—Mr. Joseph Ramsey, General Manager of the Cleveland, Cincinnati, Chicago & St. Louis, will, it is announced, retire from that office on April 1, to accept a position on another road.

—Mr. George H. Vaillant, Second Vice-President of the New York, Lake Erie & Western, sailed for Europe last week. He will be gone two months, a leave of absence for that length of time having been granted him.

—Mr. George C. Lord, ex-President of the Boston & Maine Railroad, is very ill at his residence in Newton, near Boston, and is not expected to live. Mr. Lord was President of the Boston & Maine for many years up to 1890, when he was succeeded by Frank Jones.

—Mr. A. G. Wells, Superintendent of the St. Louis division of the Cleveland, Cincinnati, Chicago & St. Louis, has tendered his resignation, to take effect March 1. His successor will be N. P. Ramsay, formerly General Manager of the Cincinnati, Wabash & Michigan Railroad.

—Mr. G. G. Cochran, has been appointed Traffic Manager of the New York, Lake Erie & Western, and his headquarters have been removed from Chicago to New York. His former title was Freight Traffic Manager of the Chicago & Erie and Western Freight Traffic Manager of the New York, Lake Erie & Western.

—Mr. Walter R. Woodford, General Superintendent of the Wheeling & Lake Erie, has resigned to accept a position with another road. His successor is Mr. Charles A. Wilson, who has been connected with the company since 1880, and has been Chief Engineer 10 years. Mr. Woodford has been connected with the company about the some length of time, as Purchasing Agent until 1887. He is a brother of Mr. M. D. Woodford, President of the Cincinnati, Hamilton & Dayton.

—Mr. Henry L. Chamberlain has been made General Freight Agent of the New York, Lake Erie & Western, with headquarters in New York, vice Theodore L. Pomeroy, resigned. Mr. Chamberlain's first railroad service was in the freight office of the New York Central, at Buffalo. He became Claim Agent of the Commercial Express Line, and was afterward Freight Claim Agent of the Erie in New York, about 10 years ago. A year ago he was made General Manager of the Erie Dispatch Fast-freight Line, with headquarters in Chicago, and removed his office to New York only a few months ago.

ELECTIONS AND APPOINTMENTS.

Aspen & Maroon Creek.—The following officers have been elected by this new Colorado company: J. E. Freeman, President; H. W. Stormer, Vice-President; W. S. Clark, Treasurer; J. F. Gooding, Secretary; Charles E. Shriver, Engineer. The headquarters are at Aspen, Col.

Berkeley Springs & Petersburg.—At a meeting of stockholders at Berkeley Springs, W. Va., the following were elected directors: R. Henter, H. W. Disher, T. H. B. Dawson, J. Rufus Smith, G. F. Weber, B. F. Deford, Samuel Whisner, G. W. Havornable, D. P. Wright, Peter Harring and Jacob Horn. The directors elected B. F. Deford, President; D. P. Wright, Vice-President; J. Rufus Smith, Secretary; Samuel Whisner, Treasurer. The road is operated by the Baltimore & Ohio.

Cumberland.—This company, which is controlled by the West Virginia Central & Pittsburgh, last week elected Col. T. B. Davis, C. Wood Daily, of Keyser, W. Va.; James A. Millholland, Hopewell Hebb and Asa Wilson, of Cumberland, Md., Directors. C. Wood Daily was chosen President and E. W. S. Moore, of the West Virgina Central & Pittsburgh Co., Secretary and Treasurer.

Delaware Lackawanna & Western.—The annual meeting of the stockholders resulted in the election of substantially the old officers and directors as follows: President, Samuel Sloan; Secretary, Fred F. Chambers; Treasurer, Frederick H. Gibbens; Managers, John I. Blair, George Bliss, Percy R. Pyne, William W. Astor, William H. Appleton, William Rockefeller, Eugene Higgins, Henry A. C. Taylor, Andrew H. McClintock, J. Rogers Maxwell, George F. Baker, James Stillman, Robert F. Ballantine and Alexander T. Van Nest. The three men named last fill the vacancies caused by the death of Wilson G. Hunt, Benjamin G. Clarke and E. S. Auchincloss.

Great Northern.—Charles C. Ponsonby has been appointed Superintendent of the Northern Division, with headquarters at Barnesville, Minn., vice C. Jenks, transferred. William D Scott has been appointed Assistant Superintendent of the Northern Division, with headquarters at Grand Forks, N. D. John F. Stevens has been appointed Assistant Chief Engineer, with headquarters at Spokane, Wash. J. C. Patterson has been appointed Engineer of Maintainance of Way, with headquarters at Great Falls, Mont., vice J. Herron, resigned.

H. A. Johnson, traveling Freight and Passenger Agent, has been appointed Division Freight and Passenger Agent, with headquarters at Seattle, Wash.

Kansas City, Nevada & Fort Smith.—Judge J. H. Orr has resigned as Second Vice-President and general counsel for the St. Louis and Hannibal Railroad to accept a position with the above company as general attorney, with headquarters at Kansas City, Mo.

Lehigh Valley.—Charles L. Rosenburg has been appointed Superintendent of Bridges in New Jersey, with headquarters at Phillipsburg, N. J.

New York, Lake Erie & Western.—G. G. Cochran has been appointed Traffic Manager of the entire system, with office at 21 Cortlandt street, New York City. The office of Western Freight Traffic Manager has been abolished. H. B. Chamberlain has been appointed General Freight Agent in charge of all freight traffic (except coal and coke) east of Buffalo and Salamanca, with office at 21 Cortlandt street, New York City.

H. A. Childs, formerly of Susquehanna, has been appointed Master Mechanic of the Eastern Division, with headquarters at Jersey City, N. J.

New York & Massachussetts.—W. H. Shelor, Receiver, has made the following appointments: Charles H. Stanton, General Superintendent, and E. L. Vanderburgh, General Ticket Agent and Treasurer, with offices at Poughkeepsie, N. Y.

Northern Pacific.—F. W. Wilsey, for several years right of way and lease agent, has been appointed Superintendent of the Lake Superior Division, with headquarters at Duluth, Minn., vice Frank Greene, resigned. Nelson C. Thrall, who has hitherto filled the office of Assistant to the President, has been appointed to succeed Mr. Wilsey. The position of Assistant to the President is abolished.

C. J. Wilson, Assistant Superintendent of the Minnesota Division, has been appointed Superintendent of the Dakota Division, with headquarters at Jamestown, N. D., vice A. J. McCabe, resigned. A. Sovereign, Assistant Superintendent of the Minnesota Division, with headquarters at Fergus Falls, has been transferred to Staples, Minn., and his jurisdiction extended over the second division of the Minnesota Division.

North Hudson County.—General Manager W. H. Starr has made the following appointments. A. Debevoise, Superintendent of Motive Power; A. K. Bonta, Supervisor of Electrical Apparatus; Nicholas Goelz, Superintendent of the horse car lines in the northern section of Hudson County, N. J.; H. Brooks, Superintendent of the Grove street and Pavonia avenue, Jersey City, horse car lines; C. R. Westcott, Trainmaster of all the locomotive and electric trolley lines.

Pennsylvania.—The following promotions of executive officers were announced Feb. 21: John P. Green, to be Second Vice-President, vice J. N. Dubarry, deceased; General Manager Charles E. Pugh to be Third Vice-President; S. N. Provost, now General Superintendent of Transportation, to be General Manager; J. P. Hutchinson, Superintendent of the Maryland division of the Philadelphia, Wilmington & Baltimore road, to be General Superintendent of Transportation; Joseph T. Richards, now Assistant Chief Engineer, to be Engineer of Maintenance of Way, a new office.

Philadelphia & Erie.—The annual meeting of the stockholders was held at Philadelphia last week and the following managers were elected: W. Hasell Wilson, President; Samuel Gustine Thompson, N. Parker Shortridge, William J. Howard, Henry D. Welsh, William L. Elkins, J. Bayard Henry, Amos R. Little, W. H. Barnes and John P. Green. J. S. Vanzandt is Secretary and Treasurer.

Velasco & Northern.—The following officers have been elected: T. J. Allen, of Kansas City, President; J. D. McGregor, of Houston, Vice-President; E. L. Perry, of Velasco, Tex., Secretary; J. M. Moore, President of the Velasco National Bank, Treasurer.

Wheeling & Lake Erie.—The annual meeting of the stockholders took place at Toledo, Feb. 14. The following directors were re-elected: G. W. Davis, S. C. Reynolds, George E. Pomeroy, and A. C. Blair, of Toledo; E. W. Oglebay, of Cleveland; John Greenough, E. K. Sibley, A. M. Soper and F. R. Lawrence, of New York. The directors re-elected the following officers: President, Frank R. Lawrence; Vice-President, John Greenough; Secretary and Treasurer, John M. Ham, of New York City.

RAILROAD CONSTRUCTION.

Incorporations, Surveys, Etc.

Baltimore & Cumberland.—The surveying now being done on this line is on the western division, between Cumberland and Hancock, Md., for which several surveys have been made. The preliminary work to Hagerstown, Md., will be actively pushed after April 1, and the Chief Engineer, Chauncey Ives, will establish his headquarters at that town in April. The line is to pass through the towns of Patterson's Depot, Oldtown, Hancock, Clear Spring and Hagerstown, connecting near the latter town with the Cumberland Valley road at a point not yet determined. Construction work will begin this year, but it has not been decided when the contract will be let.

Beaver Creek.—This company has 14 miles of standard gauge road built and in operation from Davis, Tucker County, W. Va., up Stony River. It is now used as a feeder for the West Virginia Central & Pittsburgh, hauling coal and timber exclusively. Plans are preparing for extending the line east, by way of Moorefield, Hardy County, and Mr. Thomas Daily, the Chief Engineer, with a party of assistants, is making surveys for an outlet through the Allegheny Mountains.

Canadian Roads.—Mr. Girouard, M. P., and Mr. Beauchamp, M. P. P. for the county of Two Mountains, Que., will apply to the Federal and Provincial governments for subsidies to assist in the construction of a road between the Island of Montreal and St. Placide and Grenville, Que. The line would shorten the distance between those two places and Montreal by five miles, besides taking in parishes which are now without railroad facilities.

A number of gentlemen of Sudbury, Ont., will, through their solicitors, Browning & Leask, make application to Parliament for a charter to construct a road from the mouth of the French River to Sudbury, thence northerly to Lake Wahnapitae.

A charter will be asked for to build a road from Nelson Lake, via Slocan River, in the British Columbia, thence to New Denver, and having its terminus on the Arrow Lakes.

Central Ontario.—An application will be made to the Dominion Parliament for power to extend this from Coe Hill, the present northern terminus of the road, to Bancroft, a distance of 17 miles.

Chicago & South Side Rapid Transit.—A stockholders meeting of the Chicago & South Side Rapid Transit Company, "Alley L," was held Feb. 16, in Chicago, to vote an issue of $5,000,000 of new bonds. The meeting was largely attended, a total of 69,731 shares being voted out of a possible 75,000. The vote was unanimous in favor of the bond issue. Mr. W. W. Gurley, the attorney of the company, acted as chairman of the meeting, and explained that the mortgage securing the $7,500,000 bonds outstanding was made to cover that portion of the property from Van Buren to Sixty-third street. This issue of $5,000,000 is to cover extension of the line on Sixty-third street to Jackson Park, and also the construction of branches to the Stock Yards and Englewood. The company already has a right under their charter to build the branch to Englewood, but they are inclined to build the Stock Yards branch first. This branch will probably leave the main line near Fortieth street. The charter for the Englewood branch allows the building west from a point between Fifty-fifth and Fifty-ninth streets to Wallace avenue, and south to Sixty-third street, somewhere between Wentworth avenue and Wallace avenue, but the company is disposed to favor a more direct route west. This more direct route would be along Sixty-third street, leaving the present line where it turns from the alley east on Sixty-third street. This branch would extend to or beyond Wallace street, giving Englewood patrons better facilities for getting to the World's Fair and would enable the company to build more rapidly. The selection of this route, however, or of any route to Englewood, depends upon the conferring of free right of way by citizens on the route. The company has definitely determined upon the policy of buying no more right of way for extensions in any direction, so that in whatever direction the line may be extended the property owners along the line must give the right of way. As regards the downtown loop, the view of the company is that it is a better policy to extend its line to those outlying districts from which there is a large suburban travel to the centre of the city, thereby insuring to its patrons of those outlying districts better accommodations, even though they have to walk or ride in the street cars from Congress street, than to build uptown, the idea being that the patrons would much prefer walking from Congress street to their places of business than to walk a much longer district in the suburbs.

Cleveland Transfer.—This company was incorporated in Ohio last week by officers of the Cleveland, Canton & Southern, to build a short line at Cleveland, O., apparently to complete the Cleveland Belt & Terminal road built by the company last year. The new line is to begin at a point on the Cleveland, Canton & Southern near its Broadway station and run thence northerly along the Cuyahoga River to connect with the various roads entering Cleveland and also south from the Broadway station, reaching Newburg and Brooklyn. The incorporators are H. A. Blood, J. W. Wardwell, H. R. Moore, E. T. Blood and Charles H. Blood.

Dukirk, Allegheny Valley & Pittsburgh.—The construction of a short branch from the road at Moon Station to Point Chautauqua, N. Y., is said to be under consideration by the officers. The line would be about seven miles long.

Ebensburg & Black Lick.—Charles McFadden, of Philadelphia, was on Feb. 17 given the contract for the grading of the extension from near Ebensburg to Black Lick station, Pa., about 35 miles. It is understood that the contract price is about $12,000 a mile.

Elgin, Joliet & Eastern.—Work on the branch from McCool to Porter, Ind., five miles, has been brought to temporary standstill on account of the frost. The grading and bridging are about three quarters completed. The work will be finished at once when weather becomes favorable.

Fairmont Belt Line.—Work has been resumed on the belt line at Fairmont, W. Va., being built by the Baltimore & Ohio, after being discontinued for several months on account of the weather. All the trestles are now in position and the line will be ready for the cars as far as the Sloan Glass Works, or about half its length, in two weeks.

Jacksonville, St. Augustine & Indian River.—The contract has been let for the grading, cross ties, bridge work and tracklaying from Rockledge south to Eau Gallie, Fla., 14 miles, to John D. Macleman, Montreal, Can., and Rockledge, Fla. The engineers are now making surveys from Eau Gallie to the St. Lucie River, and in case the road is extended further south, the work will be done by same contractor. The work is light, the grades are not over 25 ft. to the mile, and six degrees being maximum curvature. This new line will open up the most beautiful parts of the east coast of Florida and the best country for raising pine apples and lemons. Chas. Haines is Chief Engineer of the extensions with headquarters at Cocoa, Fla.

Kanona & Prattsburg.—The purchasers of the road at foreclosure sale last week intend to begin work early next spring on an extension from the present terminus at Prattsburg northeasterly to Geneva, N. Y., about 30 miles. A. G. Godeffroy, of 45 Broadway, New York City, is President.

Lake Superior, Algoma & Colonization.—This company is applying to the Ontario Legislature for power to construct a line from the township of Prince, thence easterly to the Canadian Pacific, in the townships of Balfour, Dowling or Bayside, with a branch from the townships of Boffin or Galbraith southwesterly to the town of Thessalon.

Mexico, Cuernavaca & Pacific.—The recent annual election of officers of the company resulted in a transfer of ownership from Denver capitalists to J. H. Hampson, railroad contractor of the City of Mexico, and D. B. Smith, of Norristown, Pa. The concession was granted to Gen. Herman Sturm, of Denver, by the Mexican Government several years ago, and last year grading was begun. The road starts from the City of Mex-

ico and extends 80 miles to Cuernavaca, Mex., the "Saratoga" of Mexico, passing through a rich sugar district. Further on the road passes through Jojulta and La Barca and reaches the rich mining region adjacent, and touches the coal district about Colcoyan. Not far from Colcoyan the summit of the line is reached. The seaport terminus is Palizado, 340 miles from the capital city. The chief engineer reported that there is not a single mile of the proposed route that will not be a freight-producing territory of agricultural, mineral or timber lands. Rails have been laid for several miles and construction work will be pushed at an early date.

Middle Georgia & Atlantic.—The company has closed a contract for the rails (60 lbs. per yard) necessary to lay the track on that part of the road between Machen and Covington, Ga., 26 miles, which has been graded for some time. Work is being done now, and it is hoped to finish the tracklaying and erect the necessary bridges during the next two or three months. The work will not be done by contract, the railroad company doing it under the supervision of J. A. Droege, of Eatonton, Ga., Superintendent.

Muscatine, North & South.—Articles of incorporation were filed in Iowa last week, the incorporators being local business men. They are William Huttig, Richard Musser, P. M. Musser, Henry Jayne and G. M. Titus, all of Muscatine, Ia. The route or length of road is not given futher than that it is proposed to build west and east of Muscatine to connect with the Chicago roads.

Nashville, Chattanooga & St. Louis.—A dispatch from Gadsden, Ala., says that the Tennessee & Coosa division of the road from Gadsden to Huntsville, Ala., will be running through trains by April 1 over the transfer at Hobbs Island, in the Tennessee River, where a boat transfer of 27 miles will be made.

Nelson & Fort Sheppard.—A dispatch from Colville, Mont., states that E. J. Roberts, Chief Engineer of the Spokane Falls & Northern road, accompanied by Assistant Engineer J. F. McCoy, left last week for British Columbia, for the purpose of arranging for the location of the road for a distance of 110 miles to Kaslo, B. C. The contracts for the construction of the road will be let as soon as the location can be made. The first work of importance to be undertaken will be the construction of the large bridge at Wanata Landing over the Pend d'Oreille River, just beyond the international boundary line, north of Northport, Wash.

Nepigon, Grand Forks & Winnepeg.—This company is applying for power to construct a road from the village of Nepigon, on the north shore of Lake Superior, thence westerly, crossing the Canadian Pacific at Linkoping, to a point at the western boundary of the Province of Ontario, near the Rainy River.

New Jersey & New York.—The double track to be built by this company will extend from New Jersey & New York Junction to Hillsdale, N. J., a distance of 14 miles. The work will probably be commenced within the next month and will be performed by the company.

New York & Long Island.—Proposals are invited for the grading and building of 15 miles of this road on Long Island. D. M. Talmage, of Philadelphia, is President. His New York office is at 61 Broadway, care of A. R. Chisolm & Co.

North Bend & Kettle Creek.—This company was incorporated at Harrisburg, Pa., Feb. 20, to build a road from near North Bend, on the Philadelphia & Erie, in Chapman Township, Clinton County, to near Stone House, on the Kettle Creek & Potter County Railroad, in Potter County, Pa., a distance of about 15 miles. F. A. Blackwell, Driftwood, Pa., is President.

Pembroke & Southern.—This company has been formed at Pembroke, Ont., and a charter will be asked for to construct a line from Pembroke southward, connecting with the Eganville branch of the Canadian Pacific and the Parry Sound branch near the village of Douglas, Ont.

Point Pleasant, Buckhannon & Tygart's Valley.—A meeting of the incorporators and stockholders of this company, chartered in West Virginia in December to build a road from Belington, Barbour County, W. Va., by way of the Tygart's Valley, River Valley and Buckhannon, to Point Pleasant, Mason County, was held in Buckhannon, W. Va., last week. The following Board of Directors was elected: J. W. Heavner, J. H. Hanson, John Crislip, C. W. Hart, J. G. Hall, William Post, John L. Hurst, T. J. Farnsworth, W. G. L. Totten, Dr. S. C. Rusmisel, Ira Ward, C. J. Goff and David Poe. The directors elected J. W. Heavner, President; J. H. Hanson, Vice-President; William Post, Treasurer, and W. G. L. Totten, Secretary. At the stockholders' meeting it was decided to make the preliminary survey in the spring along the route already described in these columns.

Seattle & Northwestern.—A charter for this line was filed in Washington last week. The road is projected from Seattle north through the Cherry Valley to a point on the Great Northern near Everett, Wash. There are at present two roads in operation from Seattle to the International boundary line.

Trinidad, San Luis Valley & Pacific.—The charter of this company was filed at Denver last week. The directors are: David Gotlieb, John Grass, A. C. McChesney, Hon. Jesus Garcia, Hon. R. L. Woolen, Hon. Casimero Barela, E. B. Sopris, of Trinidad; Hon. Fred Walsen, J. R. De Remer, Henry W. Porter, W. W. Borst, of Denver. The capital stock is $1,000,000. The plan is to build a road from Trinidad, Col., up the Las Animas River to Stonewall, thence southeast through San Francisco Pass and across the Culebra range at Costilla Pass to Durango. There will be branches from La Junta to the Las Animas; from Costilla to Fernandes de Taos in New Mexico and to Gunnison and other points. The road will be built by J. R. De Remer, a contractor of Trinidad and a preliminary survey was made for him last summer as far as San Francisco Pass.

Victoria & Sidney.—The grading will probably begin on this line on Victoria Island, B. C., within 60 days. The contractor has about 50 men now engaged in clearing the right of way, and this work is nearly completed, some of it having been done in the fall of 1892. The route of the road is from Victoria north through the Saanich Peninsula to Sidney, on the east coast of Vancouver Island, a distance of 16 miles. The grading is mostly earth work and the maximum grades are two per cent, and the maximum curvature 10 deg. The tracklaying will begin as soon as the rails arrive from England, probably in September next. The provincial government of British Columbia and the city of Victoria have guaranteed the interest at the rate of two per cent. and three per cent., respectively, for 25 years from Sept. 1, 1892, on $300,000 of bonds. These bonds have been sold in Montreal and the money is in hand for construction and equipment. The road is intended to develop the agricultural resources of Saanich Peninsula by affording cheap transportation, and give the people of Victoria access to the fine sea beach at Sidney, which the company will convert into a summer resort. This line will also shorten the distance between the port and the mainland cities by 1½ hours and obviate the stormy winter passage via the south end of the Island. Steamers from Vancouver to Victoria now pass within three minutes of Sidney, and the new road will receive this passenger traffic. The distance by steamer from Vancouver to Sidney is 47 miles. The officers are T. C. Dunlevy, President; Robert Irving, Secretary, and J. H. Gray, Chief Engineer, all of Victoria, B. C.

Wilkes-Barre & Eastern.—The grading of the road between Wilkes-Barre and Stroudsburg, Pa., 65 miles, is nearing completion and the track is being laid. It is hoped to run coal trains to Stroudsburg in May. The distance between Wilkes-Barre and New York will be 10 miles shorter by this route than by existing lines. A large coal traffic is assured. The company has, it is reported, secured a five years' lease of docks owned by the Pennsylvania Railroad at Jersey City.

GENERAL RAILROAD NEWS.

Canadian Pacific.—The company has given notice of an application to the Dominion Parliament for an act authorizing it to convert, at the option of the holders, its existing ordinary shares and registered stock, and to give the company the option of issuing registered stock in the future if authorized by the shareholders, and also to restore the clause of the charter relating to the issuance of preference stock, but limiting the amount of such preference stock to one-half the amount of the ordinary stock and share capital at any time outstanding.

Central of New Jersey.—The annual report for the year ending Dec. 31, 1892, just issued shows gross earnings of $14,716,236; operating expenses and taxes, $8,821,009; net earnings, $5,895,226. The net surplus revenues over all operating expenses, taxes, and fixed charges during the year amounted to $2,330,384, as against $2,387,445 for 1891. The passenger traffic shows an increase in receipts of $279,399. The receipts from transportation of anthracite coal were less than those of the previous year by $442,311. There was an increase in receipts from the transportation of merchandise freight and bituminous coal of $157,296.

Connecticut River.—A special meeting of the stockholders of the road was held at Springfield, Mass., Feb. 17, for the purpose of voting upon the ratification of the lease of the road to the Boston & Maine. The meeting was quiet and the result of the vote was: In favor of the lease, 17,259; against, 548.

Elk Mountain.—The property of this road was recently sold by the sheriff of Pitkin County, Col., for $177,013, the purchasers being Orman & Crook, the Pueblo contractors who did some grading on the line near Carbondale, Col., early in 1892.

Kanona & Prattsburgh.—This road was sold, Feb. 14, in Bath, N. Y., under foreclosure of mortgage, and it was bought for $70,000 by A. E. Godeffroy, of 45 Broadway, New York City, as representative of a syndicate of the bondholders. The line now in operation is 11½ miles long from Kanona, N. Y., a station west of Bath, north to Prattsburgh.

Northern Pacific.—The committee appointed at the stockholders' meeting in October last, of which Brayton Ives was the principal member, to examine into the management and financial affairs of the company, issued a report last week. It covers 29 printed pages and is signed by Henry Clews and Brayton Ives, of New York, and Jay Cooke, Jr., of Philadelphia. The proposed sale of the St. Paul & Northern Pacific, the proceeds to be used to liquidate the floating debt, is objected to on the ground that it is the best asset of the company, and should be kept in the treasury. The committee asks for proxies from stockholders to be voted at the next stockholders' meeting.

Many of the acts of the present managers are criticised, the greater part of the report being devoted to discussing the Wisconsin Central lease, and it is declared that the present financial condition of the company is largely due to its assumption of the Wisconsin Central burden. The valuation placed by the company on the land owned by the Chicago & Northern Pacific is declared to be much too high, and the Chicago & Calumet terminal is said to be unprofitable. The purchase of various branch lines and coal properties, as the Seattle, Lake Shore & Eastern, the Northern Pacific & Manitoba, the Rocky Fork Railway and Coal Trust, are said to have been ill advised. The committee reports the floating indebtedness on June 30 last as $9,289,000, which has since been somewhat reduced. Over $8,000,000 of this debt is paying eight per cent. The physical condition of the property is reported to be excellent. The committee recommends a reduction of the mountain grades, and is of the opinion that by an expenditure of $3,000,000 an annual saving of $750,000 would result.

Edwin H. Abbot, President of the Wisconsin Central, has replied to the charge made by the committee that the lease of the Wisconsin Central has been a source of loss to the Northern Pacific. Mr. Abbot contends that the Wisconsin Central has shown extraordinary growth in its business, and has yielded a profit on the lease. He contends that the purchase of the terminals of the Chicago & Northern Pacific, in Chicago, was a wise step, and that the stock of the Chicago & Northern Pacific is an asset in the treasury of the Northern Pacific worth nearly $2,000,000 in cash. Brayton Ives in a rejoinder to Mr. Abbot's letter says that the earnings of the Wisconsin Central's mainline go to pay interest and dividends on the bonds and stock of the leased lines.

Oshkosh & Mississippi River.—This line which is 20 miles in length, extending from Oshkosh to Ripon, Wis., it is reported has passed into the control of the Chicago, Milwaukee & St. Paul. It has been operated by the latter company under a lease ever since it was built 21 years ago.

Philadelphia & Reading.—For the third time in its history this railroad has passed into the hands of receivers under the stress of the financial troubles that have almost destroyed its credit and depressed its securities to the extent of many millions of dollars. The step was taken on Monday, Feb. 20, on the application of Thomas C. Platt, of New York, the holder of $55,000 third preference bonds, the interest on which has not been paid, and on his prayer Judge Dallas, in the United States Circuit Court, appointed President A. A. McLeod, Chief Justice E. N. Paxson of the State Supreme Court, and President E. P. Wilbur of the Lehigh Valley Rail road, receivers for both the railroad company and the coal and iron company. At the same time George L. Crawford was named as master to pass upon the accounts of the receivers, and each of the latter was required to enter a bond for $500,000. In order to qualify himself for the position Chief Justice Paxson at once sent in his resignation to the Governor, by whom it was accepted. The receivers filed their bonds at once and will enter upon the management of the company immediately.

Tennessee, Alabama & Georgia.—It is announced that a number of roads in Georgia and Tennessee and other states in the Southeast are to be amalgamated under the above title. Mr. Newman Erb, of Kansas City, who has been arranging the details of the scheme for the last year, will be the President of the new company. The roads to be taken into the combination are the Chattanooga Southern, the Marietta & North Georgia, the Knoxville, Cumberland Gap & Louisville, and the Morristown & Cumberland Gap. These lines will form a route from Cumberland Gap, through Knoxville and Marietta to Atlanta, Ga. No financial or other details are given.

TRAFFIC.

Traffic Notes.

The Pacific Mail Steamship Company has restored freight rates from San Francisco to Central American ports, the rival steamship line having apparently been killed off.

The Star Union Line has withdrawn its business from the New York & New England, the change to take effect March 1. This is understood to be a move on the part of the Pennsylvania to favor the New York, New Haven & Hartford.

Mr. C. P. Huntington and other men interested in the Pacific Mail Steamship Company announce that negotiations are being had looking to an amicable traffic arrangement with the Panama Railroad, but the officers of the latter say that they know of no change in the situation.

The large reductions in west bound freight rates by the northern trans-continental lines have caused a great deal of discussion in the cities interested. The people of Spokane seem to have been taken by surprise, and they hardly know whether they are pleased or otherwise, as the reduction to Pacific Coast points leaves the rates in such shape that the advantage they expected to gain by the reduction is of doubtful value. The jobbers of Minneapolis complain that the reduction is larger, proportionately, for Chicago shippers than for them.

Chicago Traffic Matters.

CHICAGO, Feb. 22, 1893.

Transcontinental passenger rates are still in a bad way, and are apparently getting worse instead of better. The Rock Island has given notice to the Southern Pacific and Santa Fé of its withdrawal from the eastbound passenger agreement, alleging as its reason for so doing that the other companies are violating it. An attempt is being made to obtain a meeting of the interested lines at San Francisco next month, and try to resurrect the Trans-continental Association.

Chairman Midgley gives notice that lines in the Western Freight Association east of the Missouri River and St. Paul will be at liberty to protect the new rates to North Pacific Coast points and accept in connection therewith the established divisions, this arrangement to continue until March 31, with the expectation that before then other arrangements will be made.

Commissioner Blanchard has issued a circular in regard to transcontinental rates, calling attention to the resolutions adopted by the Freight Committee at its last meeting in view of the dissolution of the Transcontinental Association, to the effect that all requests for changes in rates, in force at the time of the dissolution of the Association, should be made to Mr. Blanchard and not to individual lines. The Commissioner now states that until new rates are requested of and duly authorized, either by the Joint Committee or the Central Traffic Association, Central Traffic lines will continue to exact their heretofore agreed proportions of the old tariffs.

The arbitrators chosen to settle the question of passenger rates in the territory of the Chicago & Ohio River Association, A. F. Walker, George R. Blanchard and F. C. Donald, have issued their decision. The rates fixed are: Chicago to Cincinnati, unlimited, $8.80; limited, $8. Chicago to Louisville, unlimited, $9; limited, $8; Chicago to Indianapolis, unlimited, $5.50; limited $5. From Chicago to Dayton the rate is advanced to $7.50 and to Columbus to $9.20. All the old figures are restored on mileage tickets as well as the rates for parties of 10 or more. In fact, the arbitrators have put all rates back to the basis in effect prior to the outbreak of the recent war. Provision is made in the agreement for the redemption of tickets found on the market, and each road is required to place $2,000 in the hands of the commissioner of the association to be applied on such redemptions. The advanced rates are to become effective March 7.

The shipments of eastbound freight, not including livestock, from Chicago, by all the lines for the week ending Feb. 18 amounted to 75,663 tons, against 71,333 tons during the preceding week, an increase of 4,330 tons, and against 94,013 tons during the corresponding week of 1892. The proportions carried by each road were:

Roads.	W'k to Feb. 18.		W'k to Feb. 11.	
	Tons.	P. c.	Tons.	P. c.
Michigan Central	12,685	16.8	9,177	12.9
Wabash	5,896	7.8	6,842	9.6
Lake Shore & Michigan South.	12,464	16.5	16,237	22.8
Pitts., Ft. Wayne & Chicago	12,622	16.7	6,627	9.3
Pitts., Cin., Chicago & St. Louis	4,322	5.7	5,117	7.2
Baltimore & Ohio	5,230	6.9	5,594	7.8
Chicago & Grand Trunk	7,459	9.8	6,627	9.3
New York, Chic. & St. Louis	5,553	7.3	4,218	5.9
Chicago & Erie	7,110	9.4	8,521	11.9
C., C., C. & St. Louis	2,322	3.1	2,373	3.3
Totals	75,633	100.0	71,333	100.0

Of the above shipments 11,098 tons were flour, 37,814 tons grain and millstuff, 6,252 tons cured meats, 11,214 tons dressed beef, 2,115 tons hides, and 3,333 tons lumber. The three Vanderbilt lines carried 40.6 per cent., the two Pennsylvania lines 22.4 per cent.